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Forthcoming Events.

DECEMBER 17.

Institute of British Foundrymen (Birmingham, Coventry and West Midlands Branch):—Ordinary meeting at Birmingham. "Foundry Casting," Paper by C. Dicken.

DECEMBER 18.

Institute of British Foundrymen (Sheffield and District Branch):—Ordinary meeting at Sheffield. "Casting Design," Paper by F. W. Rowe, B.Sc.

West of Scotland Iron and Steel Institute:—Ordinary meeting at Glasgow. "Speed Control in Relation to Modern Rolling Mill Drives," Paper by L. Rothera, B.Sc.

DECEMBER 19.

North of England Institute of Mining and Mechanical Engineers:—Ordinary meeting at Newcastle-on-Tyne.

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Foundry Design.

About five years ago we organised a competition with the object of producing some really good designs for foundries. On the whole we were quite successful, but since that time our ideas have undergone a radical change.

At the moment we are leaning towards a double-size rectangular shop, with the cupola plant placed centrally along its longer side. On Monday, say, the bay at the right-hand side of the cupola would be used for actual moulding. We are, of course, presuming that the work turned out would be of the type that could be moulded and cast up in the same day. Then, on Tuesday, the moulders would be shifted in their entirety over to the left-hand half of the shop, and labourers, under adequate supervision, would clear up the half used on Monday. This system would involve extra initial lay-out for both buildings and a certain amount of plant, but the complete separation of the mould "constructors" from the mould "destructors" would allow of the better organisation of work. For instance, the psychological effect of entering a definitely tidy foundry, with everything to hand ready to start work, must have a profound effect on output. It should, of course, be possible to do all this by means of a night gang, but anyone who has had charge of a foundry knows how expensive a night shift can be. Maybe there is some heavy tackle to shift, and a crane man is brought for less than two hours' work. He is given a whole shift, and because he is idling his time away he generally finds someone to "help" him. Generally speaking, it is rare that a night shift of this character is an economic proposition.

It will no doubt be contended that when trade boomed encroachments would be made into the other half of the foundry. This from our view would only have to be a temporary arrangement, and the object to be sought would be the creation of a complete night shift working in the opposite bay to the day shift.

In the case of stationary machines turning out large numbers of repetition castings, we suggest that the allotted area for that machine should be hypothetically divided into Monday, Wednesday and Friday, and Tuesday, Thursday and Saturday. Obviously they could very largely overlap, but there could be the same insistence that Monday area must be in perfect condition for starting work on that day. If "junk" was being continually transferred from the one to the other, the labourer would obviously complain. For instance, in a malleable cast-iron foundry the common ground for all days might overlap to the extent of 90 per cent., which would leave a strip on opposite sides of his bay which he is unable to use except on its particular day. This method, of course, involves that the whole of the floor space is used every 48 hours, and effectually prevents accumulations of seldom-used or obsolete material. It represents a compromise on the first system outlined, whilst tending to stop moulders being hindered in their work by the presence of general labourers engaged on clearing away boxes, etc. In other words, the general labourers have their own territory in which to work.

Physical Testing of Foundry Materials.

At a well-attended meeting of the Lancashire Junior Section of the Institute of British Foundrymen, held on December 12, in the College of Technology, Manchester, Mr. J. S. G. Primrose, A.R.T.C., gave a comprehensive lecture on the important subject of testing foundry products. The differences between *proof tests*, such as were applied to the finished article, and *specification tests* employing test bars or coupons were stressed and explained in detail.

In explaining the individual tests usually employed, it was emphasised that the tensile test must be very carefully conducted, and that truly axial loading was essential for accurate and reliable results. The most commonly used and perhaps the more reliable test was the transverse test. The types of bars demanded by the Admiralty, India Office and the A.S.T.M. were described. The fact that no accurate formula existed, which allowed of load conversion from the size of bar being tested to another size for comparison, was explained by mass effect; and figures were quoted which clearly showed the effect of this on the same mixture of iron. The compression test to afford any accurate information must be carried out on cylinders of which the length diameter ratio was not less than 1.5. Some interesting tests on die pressed cast iron were quoted and illustrated that cast iron under certain conditions was malleable.

Shearing tests, though less common, were important and also very reliable. The work of Frémont and Ronceray, who trepanned small cylinders from the actual castings, was quoted. The shear test had an advantage over the tensile test in that one could select where the test piece should break. In well-conducted tests the shear stress was equal to the tensile strength.

In dealing with hardness tests, the real meaning of the test so made by Brinell was lucidly explained. It was resistance to penetration that was measured. A common fault was to look upon the Brinell number as simply a number. That was a mistake; it had dimensions and should be expressed in kilos per square millimeter. The Shore impact hardness test gave indications of quite another character. As recently shown by the B.C.I.R.A., the hardness tests on cast iron were of little value. A more practical test such as the drilling test of Keep in America and Cook in this country was of use, but it had to be performed under standardised conditions in order that comparisons could be made.

Impact tests were sometimes called for. The Bureau Veritas percussion test was cited, and some remarkable figures for maximum-pearlite iron quoted.

The shrinkage tests as performed by Keep were of practical value, and if used intelligently were a sound test for the foundryman. Definite figures were obtained, and these were related directly to the silicon content when other conditions were standardised. Growth tests were essential, but we had yet to devise a simple quick test which would indicate how iron would behave under repeated heatings and coolings. The work of Carpenter and Rugan, also Andrew and Higgins, was quoted in this connection.

Some excellent lantern slides, simply yet fully explained, conveyed to the members how the tests were made. The machines depicted embraced universal machines of the Amsler type, tensile machines of the lever type, hardness machines, impact machines for transverse, tensile and percussion impact, and also the latest type of repeated impact tester.

DISCUSSION.

MR. MAKEMSON, in opening the discussion, said that one could but think that testing cast iron was rather in the nature of a venture. With steel one was reasonably sure that a representative sample was obtained. He opined that some buyers and inspectors still had a childlike faith in test bars for cast iron. They thought that if the test bar was good, then so also was the casting. If one cut up a casting into test bars, then it was almost certain that for each bar pulled a different result would be recorded. Also the hardness for each bar would vary. He did not mean that test bars were useless; on the contrary, if one took daily test bars from each important mixture used, then a comparable series of tests were obtained which had a relation to the quality of castings produced. What was the relative value of the transverse and tensile tests? The tensile test was coming more into use now.

MR. YEOMAN inquired why the crushing test specimens always broke at 55 deg. Was it due to the internal crystalline arrangement or shape? Would a test bar cast on the casting give better results than one separately cast, or than a bar machined from the actual casting?

In reply MR. PRIMROSE said that the tensile test always revealed the weakest part of the bar. The tendency to fail at one end of a bar was not always due to undercutting or tapering, yet cast-iron bars more commonly broke near the shoulder of the bar. The tensile test was not so valuable as the properly conducted transverse test. Transverse tests combined tensile and compressive stresses. He thought that the general soundness of the iron was better revealed by the transverse test.

With regard to the 55 deg. shear, that angle seemed to be indigenous to cast iron. Comparing it with steel, in which metal the angle was 45 deg., it always remained a constant. It was not directly connected with any internal crystalline arrangement. In the case of the forged (or pressed) cast-iron fuze quoted, when these were tested under a steam hammer blow, a conical fracture occurred and the cone dimension was always constant. A cast-on bar was more representative of the casting, provided the bar was suitably placed in relation to mass and proper arrangements for clean running made. A separately-cast bar was usually stronger. Illustrative of the other point was a test he had made on a fractured bedplate. A slice of metal was cut off right at the fracture where the section was a large one. A tensile test gave 6.5 tons only, as compared with a separately cast bar which gave 11.5 tons. Re-design, by coring out, increased the strength by 100 per cent. at that point, and a reduction in weight was also affected.

A vote of thanks proposed by Mr. Ollier and seconded by Mr. Yeoman was carried by acclamation.

The next meeting was announced to take place on January 16, when Mr. S. G. Smith will take for his subject "Factors that Constitute Problems in the Iron Foundry."

Correspondence.

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Special Irons.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The correspondence appearing in your paper on the subject of "Perlit," "Emmel," and other special processes for producing Pearlitic castings is serving a very useful purpose in the interests of the foundry trade generally, but I do feel that much of the criticism is beside the point. Surely we are quite ready to believe that they can ensure a pearlitic fracture with consequent high strength, because it is on record that several British foundrymen have done the same thing years ago, and I believe it to be a fact that certain foundrymen to-day can and do produce pearlitic structure chiefly by a careful selection of their raw materials. If by any of these processes it is possible to obtain the results with greater certainty or at less cost, I am sure every progressive founder would be interested. It seems to me, therefore, that the following points have a very material bearing on the matter:—(1) Capital cost of installing the necessary additional plant; (2) estimated increase in the cost, if any, of producing castings, including royalties, etc.; and (3) whether a technical staff is necessary to control the process.

If these questions can be answered satisfactorily I am sure that no better method of propaganda could be devised, and none which would appeal more to the average foundryman, who is, I firmly believe, in spite of attempts in some quarters to decry him, a man of parts and quite able and willing to march with the times.—Yours, etc.,

GEO. BEAUFORT RICHARDS.

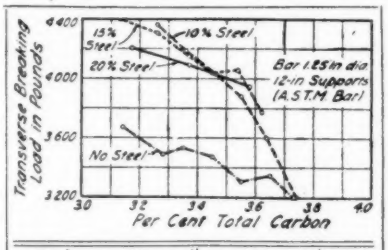
On the Relation of the Constitution of Grey Iron to its Engineering Properties.*

By J. W. Bolton, The Niles Tool Works, Hamilton, Ohio.

A fundamental problem in the grey iron field is the correlation of knowledge of the constitution of grey iron to what is known about iron's engineering properties. It is only by means of such correlation that the data of testing and research attain practical value. An outline of the relationships existing offers a logical foundation on which further investigation can be based.

In many tests, especially tests of mechanical properties, the exact condition of the metal used was not determined. As a result, numerous unexplained discrepancies detract from the practical value of such work. To-day the methods of physical metallurgy furnish means for more thorough study.

The service of grey iron depends largely on its strength and resistance to wear. From the manufacturing viewpoint, cost, ease of casting,



Total carbon per cent.	Average silicon per cent.	Transverse breaking load-lb.	Total carbon per cent.	Average silicon per cent.	Transverse breaking load-lb.
20-25% Semi-steel (88 Bars Tested)			10% Steel (111 Bars Tested).		
3.17	About 1.30	4,205	3.26		4,360
3.37		4,090	3.37		4,150
3.58		3,945	3.46	About 1.65	4,035
15% Steel (135 Bars Tested)			3.55		3,880
			3.64		3,600
3.13		4,400	3.74		3,200
3.26		4,305	No Steel (211 Bars Tested)		
3.36	About 1.50	4,180			
3.45		4,040	3.14		3,672
3.54		4,060	3.28		3,490
3.62		3,780	3.35	About 1.75	3,535
			3.45		3,470
			3.55		3,305
			3.65		3,345
			3.73		3,205

FIG. 1.—EFFECT OF TOTAL CARBON CONTENT ON THE TRANSVERSE STRENGTH OF A.S.T.M. STANDARD TEST BAR.

machinability, and appearance are important. The best measure of the true worth of an iron is its performance in actual service. Direct experimental work is rarely done by means of tests under actual working conditions. The cost of such experiments is often prohibitive, and the time required is so long that the work may be obsolete long before completion. The engineer relies largely on simpler and quicker tests. Such tests furnish him an idea of comparative properties, from which he can deduce the probable values of the different materials when in actual service. IN course of time he is enabled to check these deductions against the performance of the material under actual service conditions.

The following outline gives some of the more commonly used tests for grey irons:—

(A) *Strength.*—(1) Static: (*a*) Transverse (and deflection); (*b*) tensile; (*c*) shear; (*d*) crushing. (2) Dynamic: (*a*) Impact and (*b*) fatigue.

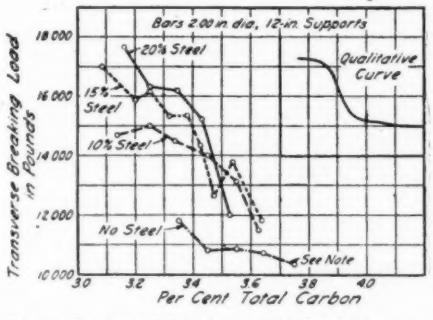
(B) *Hardness.*—(1) Resist indentation: (*a*) Brinell and (*b*) Rockwell. (2) Rebound: (*a*) Shore scleroscope. (3) Scratch: (*a*) Diamond point and (*b*) relief polishing.

(C) *Constitution.* — (1) Ultimate chemical analysis. (2) Structural tests: (*a*) Macroscopic; (*b*) microscopic; and (*c*) ultra-microscopic.

* A Paper read before the Franco-Belgian Congress at Liège on behalf of the American Foundrymen's Association.

This list can be extended indefinitely. For example, there are drill tests, chill tests, shrinkage tests, fracture tests, tests on volume changes, electric and magnetic properties tests, thermal tests, X-ray tests, corrosion tests, etc.

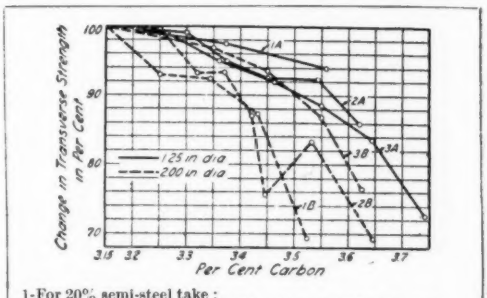
This Paper is limited to consideration of some of the more common mechanical tests and the related engineering properties, and to the correlation of these tests to observations on the structure of grey iron. A general conclusion advanced is that the parts of which it is made and the



NOTE: The effect of higher silicon is to thrust the curve towards the left. See qualitative curve.

FIG. 2.—EFFECT OF TOTAL CARBON CONTENT ON THE TRANSVERSE STRENGTH OF A 2-IN. TEST BAR.

way they are put together determine the performance of a piece of metal. As a generalism this will not be denied. It is the structural viewpoint. A second conclusion—also agreed on by most metallurgists—is that the condition of the carbon determines the properties of the metal. The third thought advanced is that the properties of the casting can be predicted from the properties of the bar. Throughout this Paper emphasis is laid on how the various phenomena come about.



1-For 20% semi-steel take:
A-4,200 lb. as 100% on 1.25 in. bar at 3.15% Carbon.
B-17,500 lb. as 100% on 2.00 in. bar at 3.15% Carbon.
2-For 15% semi-steel take:
A-4,400 lb. as 100% on 1.25 in. bar at 3.15% Carbon.
B-16,500 lb. as 100% on 2.00 in. bar at 3.15% Carbon.
3-For 10% semi-steel take:
A-4,400 lb. as 100% on 1.25 in. bar at 3.15% Carbon.
B-15,000 lb. as 100% on 2.00 in. bar at 3.15% Carbon.

NOTE: For all practical purposes the No-Steel Curve (omitted) has the same qualitative significance as those plotted. The essential thing demonstrated is that "Carbon has greater influence in heavier sections."

FIG. 3.—ILLUSTRATES THE CHANGE PER CENT. IN THE TRANSVERSE STRENGTH CORRESPONDING TO THE CHANGES IN TOTAL CARBON.

To avoid complexity the number of variables directly considered has been made as small as possible. For this reason only the elements silicon and carbon are charted.

Transverse Tests.

The transverse strength of grey iron depends on (1) the amount and distribution of graphite; (2) the degree of graphitisation; (3) the condition of the "combined" carbon; and (4) the general grain size (including graphite size). These are deter-

mined largely by (1) the per cent. total carbon; (2) the cooling rate; and (3) silicon and other elements.

Fig. 1 shows the relation of per cent. total carbon to the transverse strength of several irons (other elements approximately constant) as determined on the standard A.S.T.M. bar.

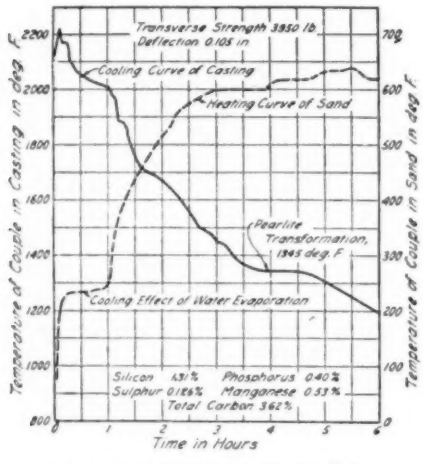

Transverse Strength 3950 lb.
Deflection 0.105 in.
Cooling Curve of Casting
Heating Curve of Sand
Pearlite Transformation, 1345 deg. F.
Cooling Effect of Water Evaporation
Silicon 1.31% Phosphorus 0.40%
Sulphur 0.126% Manganese 0.53%
Total Carbon 3.62%
Temperature of Couple in Casting in deg. F.
Temperature of Couple in Sand in deg. F.
Time in Hours

FIG. 4.—SHOWS A COOLING RATE CURVE.

Fig. 2 shows the relation of per cent. total carbon to the transverse strength of several irons as determined on 2-in. dia. bars.

Fig. 3 shows the percentage strength changes on the two size bars due to changes in the total carbon.

FIG. 5.—GRAPHITE FLAKE SHOWING NETWORK. MAG. 850 DIAS. POLISHED.

It is evident that for the irons considered the total carbon has greater influence in the heavier bars, because the more the graphitisation, the greater the grain size.

Cooling rate depends very largely on the relationships between surface and volume, initial temperature, thermal reactions within the metal, conductivity of surrounding medium and the room temperature. Of these, the relationships between surface and volume are most widely variant, hence section size is the most significant factor influencing cooling rate.* Fig. 4 shows an actual cooling rate curve.

From these considerations it is evident that: Increase in graphite causes decrease in strength, and the tenacity of the metal is lowered by inclusion of a greater amount of this weak component.

Since the paths of the flakes are so nearly continuous throughout the metal, and since the graphite itself is non-coherent, assumption of network within the flakes is a plausible theory which accounts for the considerable strength of grey iron (Fig. 5). The idea of a ferrite network was first advanced by Howe. The author has examined the flake structures carefully. Nearly

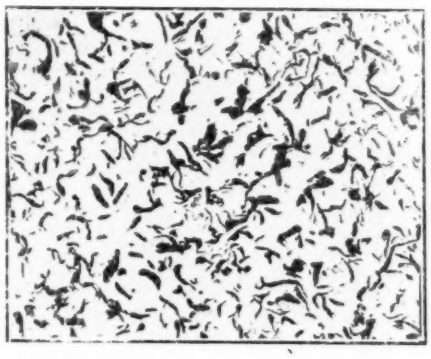


FIG. 6.—SHOWS THE STRUCTURE OF AN IRON WHICH REGISTERED 5,600 LBS. ON STANDARD TRANSVERSE SQ. IN. A.S.T.M. TEST BAR. UNETCHED.

all are scooped out in the polishing operation. In many cases close observation reveals a bright network appearance which suggests ferrite. Occasionally globules of manganese sulphide are contained within the flakes.

Graphite flakes occur in segregations of either the whorl or dendritic types, according to the composition of the metal. While the individual grains of the whorl may be very tiny, whorl formations break up the continuity of the metal

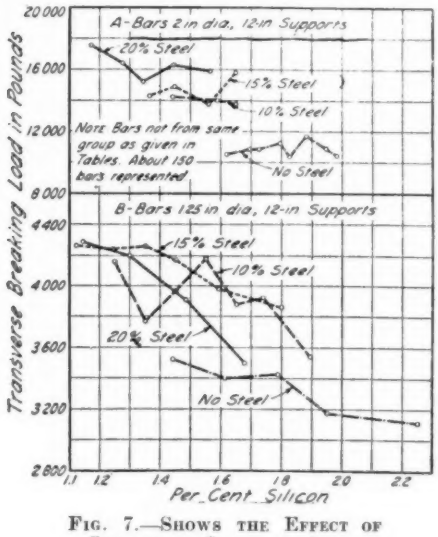
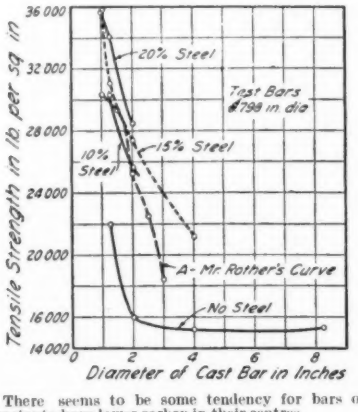


FIG. 7.—SHOWS THE EFFECT OF SILICON ON IRONS OF APPROXIMATELY CONSTANT CARBON.

quite effectively. For this reason decrease in strength with increase in carbon is usually more marked in the higher carbon ranges. Sometimes an iron is found which possesses very uniform graphite distribution, and whose strength may prove exceptional (Fig. 6).

* The ratio $\frac{\text{volume}}{\text{surface}}$ is practically a straight line for bars whose length is several times the diameter $\frac{\text{Vol.}}{\text{sur.}} = \frac{\pi r^2 h}{2\pi r h + \pi r^2} = \frac{rh}{2H+r}$. Then when h is large compared to r the relation progresses nearly as $\frac{r}{2}$.

In an iron of given graphitic conditions, decrease in pearlitic implies lowering in strength. This phenomenon is closely related to the others considered. Its effect is most accurately demonstrated by means of annealed irons. Under proper conditions an annealed iron shows slight change in grain size. Comparisons can be made between annealed low-carbon irons and approximately pearlitic irons of higher carbon content. Such comparisons show that the decrease in pearlite (combined carbon) in itself has less effect than might be expected. For example, ferritic irons (0 combined carbon) and 3.2 per cent. graphite of small grain size, may show only 20,000 lbs. (8.8 tons) tensile strength with a Brinell hardness 100 to 110. An iron 0.80 combined carbon and 3.2 per cent. graphite (*i.e.*, 4.0 per cent. total carbon) of approximately the same grain size and much higher Brinell will not have much greater strength, but such annealed irons show much greater strength than ordinary ferritic iron, the differences being largely in the grain size. On the other hand, it is common foundry experience that low combined-carbon indicates a weak iron. This is because conditions promoting low combined-carbon in the casting also promote formation of more graphite and increased grain size.



NOTES: There seems to be some tendency for bars of larger diameter to have lower carbon in their centres.

FIG. 8.—ILLUSTRATES THE RELATION OF TENSILE STRENGTH TO SECTION SIZE.

Changes in the strength of grey iron are made by converting the pearlite into sorbite, troostite, or martensite. The yield-point of carbon steels can be doubled by suitable heat treatments. In so far as the author is aware, similar results have not been obtained with regular grey irons. Ordinary treatments to produce machinable iron result in increases of 20 to 50 per cent. in strength. This is, of course, assuming little resolution of graphite and that the iron contained no free cementite before treatment.

Grain size is a very potent factor. The greatest changes effected by section size are the changes in grain size.

The various metals, non-metals, and metalloids occurring in grey iron affect the strength by: (1) Stabilisation of the cementite, *i.e.*, lessening graphitisation, *e.g.*, chromium and high manganese; (2) increasing the strength of the matrix. Nickel (while at the same time promoting graphitisation) changes the pearlite to other stronger transition forms; (3) affecting graphitisation mechanically. Phosphorus possibly has such an effect in some cases; (4) influencing the formation of smaller cementite groups, hence graphite flakes through action of nuclei. No element has been positively shown to do this; (5) changing the carbon concentration of the eutectic; (6) promoting the formation of graphite, using silicon and carbon; and (7) altering the pearlitic transformation range. Various alloying elements have this effect. The phenomena noted under (2) is attributed to this.

In Fig. 7 the effect of silicon on strength of irons of approximately constant carbon content is shown. Silicon exerts less influence in the more slowly cooled sections.

Tensile Test.

The tensile strength of grey iron depends on the: (1) Amount and distribution of graphite; (2) degree of graphitisation; (3) condition of the combined carbon; (4) general grain size; and (5) freedom from shrinkage.

As in the case of the transverse test, these factors are dependent on the total carbon, the cooling rate, and the various elements. However, many of the effects differ in degree from those observed in transverse testing.

The effects of section-size variance are greater in the tensile test. This is shown in the section tensile curves (Fig. 8). The similarity in the character of results obtained by different investigators is interesting. The Niles irons (1) and (2) are well adapted for general machinery castings which have both heavy and light sections. The lowness of Mr. Rother's results* for heavier sections are in part attributable to his use of a smaller test bar (0.505 dia.) and the higher total carbon content of his metal (3.7 per cent).

From study of the data submitted it is evident that lowest strength (for any given iron) occurs when the iron is in equilibrium. When in equilibrium, that iron which possesses lowest carbon

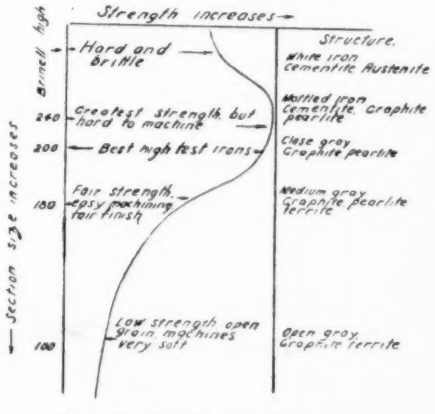


FIG. 9.—QUALITATIVE DIAGRAM OF THE EFFECTS OF SECTION SIZE ON STRENGTH.

content and smallest grain size will have the greatest strength. Highest usable strength is attained when "primary" graphitisation is completed and before further grain growth can take place. Of any two irons at this point that with lower total carbon is usually the stronger. Fig. 9 is a qualitative representation of the effects of section size on strength.

Since shrinkage usually takes place close to the neutral axis, its effect on transverse strength is negligible. In tensile tests from centres of heavy sections shrinkage is a very important factor. It is the author's experience that heavy cylindrical sections poured cool have a tendency to pipe, showing shrinkage in the upper central portion. While such shrinkage may be almost invisible to the naked eye, it has a profound effect on the strength. For this reason heavy test bars should be poured either at a definite temperature or at the temperature at which the corresponding castings are poured.

There is no logical transverse-tensile ratio. The practice of using such a ratio is equivalent to making comparisons of different irons. The ratio varies widely for different irons. It is the author's observation that presence of either whorl or uniform flakes indicates that the ratio will be about $7\frac{1}{2}$ or 8 to 1 in the 1.25-in. diameter A.S.T.M. bar, whereas when dendritic segregation is prevalent the ratio may be higher.

While transverse tests probably give the most satisfactory idea of the strength of the section as cast, the tensile test gives a more accurate and certainly more conservative figure for the strength of parts where finish allowance has been large.

(To be continued.)

* Iron Age, August 7, 1924, Table I.

XUM

Manufacture and Use of Wrought Iron.

By H. E. SMITH.*

There are many engineers who adhere to the idea that wrought iron of good quality is an especially safe and reliable material for severe service conditions. In case of doubt, the probabilities may be in its favour. This preference in most cases follows actual experience, but the basic reason is doubtless to be found in the structure of the metal. A bar of wrought iron may be likened to a wire rope. A bar of steel is solid, and the more nearly perfect the steel the more nearly solid and uniform is the bar. The wrought iron, starting with a mass of globules of metal in a bath of slag, is in its finished condition a bundle of fibres, each surrounded by a very thin film of slag. Obviously, a surface crack or check is less readily propagated in such a structure.

We often hear the remark that present-day wrought iron is not as good as that made many years ago. It is true that the manufacturer of reworked scrap has the problem of excluding steel scrap, which was not a factor in former years. There is evidence, however, that the wrought iron made to-day entirely from pig-iron is superior to some of the product of our grandfathers. Modern metallurgists have a more precise knowledge of the pig-iron and other raw materials, and of the nature of the reactions in the process, which helps to a better and more uniform product.

In past years it has often been thought that the impurities in wrought iron are contained mostly in the intermingled slag, and that therefore the results of analysis are not instructive concerning the quality of iron. This appears to be true only in a very limited degree. Some of the impurities are mostly in the metal itself.

With respect to chemical composition in general —carbon should obviously be present in only minute amounts, not over 0.08 per cent. Large amounts indicate either steel or imperfect puddling. Manganese over 0.10 per cent. gives the same indications. Phosphorus may without injury be present in amounts which would be injurious to steel, but even in iron there is a limit. Leaving out of consideration iron made from charcoal pig (which is not a large factor in the total supply), the highest grade of puddled irons may contain up to 0.10 per cent. phosphorus. Irons for large bolts, forgings and similar purposes may apparently contain up to 0.18 or 0.20 per cent. phosphorus without injury. Larger amounts show a definite effect. An extensive series of drop tests on large forgings showed progressively increasing failures from 0.25 to 0.60 per cent. phosphorus, the latter being the highest found.

In the author's experience sulphur is rarely high enough to be troublesome. Quite a little silicon will be found in the intermingled slag. The determination of slag is an important one, but is in need of further study, both with regard to the method for its separation and the composition of the slag. As now determined by solution of the sample in iodine, the amount in high-grade puddled coke irons is about ½ to 1 per cent. From this figure the amount rises to 2 per cent. in less thoroughly-worked commercial irons. The slag contains a large amount of iron oxide and some silica. It usually contains but little phosphorus, even when the percentage in the iron is high.

The place which wrought iron holds in the opinion of consumers is largely indicated by the uses to which it is put. When high unit strength is necessary, preference must obviously be given to steel. Where lower strengths are permissible but the utmost reliability is required, conservative users often hold to iron.

In railroad operation the use of iron for boiler staybolts is prominent. All makers of staybolt iron do not follow exactly the same methods, but as a rule the iron is "double worked," meaning that the original muck bar is twice cut, piled and re-rolled. The box form of piling appears to have some advantage, in giving more uniform vibratory strength in all directions, and also in containing fewer welds in the outer portions where the threads are cut. Fitted engine and machinery bolts are made from iron or steel according to the ideas of the user. The iron should be of good quality, free from steel, and the piles for re-rolling should contain no short pieces.

Practice is also divided with respect to large forgings which are subjected to severe conditions of heavy loads combined with repeated shocks. In this class are the drawbars connecting locomotives with their tenders; also the larger locomotive and car equalisers. Such forgings are 1½ to 4 in. thick and 6 to 10 in. wide. Many engineers have adhered consistently to the best wrought iron for these forgings, although soft or extra soft steel is not without successful records.

For chains for heavy crane service, wrought iron is frequently preferred.

In large office buildings, hotels, and similar structures the systems of steam and water pipes are extensive and complicated. The pipes are often accessible only by tearing down considerable interior finish, which makes renewals costly. For such conditions wrought iron finds favour.

In shipbuilding, wrought iron is sometimes used for stern posts on account of its greater resistance to corrosion. The same is true of the supports under the marine boilers.

In electrical work the special magnetic qualities of wrought iron give it preference for some purposes.

This is an opportune point at which to mention the basis of equivalence in strength between wrought iron and steel as affecting the design of structures and the substitution of one material for the other. Designing engineers have sometimes replaced wrought iron with extra soft steel of 45,000 to 50,000 lbs. ultimate tensile strength, this being the strength of the iron. It should be remembered, however, that the yield point in iron is relatively higher than in steel, and that to obtain the same yield point and service efficiency in steel, 55,000 to 60,000 lbs. is necessary. The higher the strength of the steel, however, the more sensitive it is to checking.

In attempting to substitute the cheaper soft steel for threaded bolts and pipes, consumers have at times encountered increased difficulty in rapid thread-cutting, particularly in the case of open-hearth steel. The slag films in the iron make it more free cutting than the more homogeneous steel. Grinding the tools with more clearance and more "rake" helps this condition, but presumably at the expense of more rapid wear of the tool. The steel-maker's remedy in the case of bolts has been high manganese sulphide. This has facilitated threading, and for some purposes the steel has been quite successful. For the most exacting conditions, iron is still the more dependable material.

Examples of old-time wrought iron which have withstood severe conditions for many years are familiar. Two very striking ones have recently come to the author's attention. One is a 90-in. aqueduct pipe of rolled wrought-iron plate ½ in. thick. It has at times been only partly filled with water, therefore exposed to both air and water. After 60 years' service it was much corroded, but still in service. The other example is a horizontal pipe line exposed on the Jersey sea coast for 11 years. Two adjoining lengths of steel pipe are corroded entirely away in the lower half of their circumference, while the wrought-iron coupling which joins them is still intact.

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Harriman Concession for Manganese Ores.—The rumours that a misunderstanding has arisen between the Harriman group and the Soviet Government in the matter of working the manganese mines at Tshiaturi has been officially contradicted by the Soviet Press Bureau.

Demand for Steel Rails.—The demand for steel rails in non-producing countries, as judged by the combined exports of the United States, Great Britain and Germany, is much less now than it was in 1913; Germany's proportion of the total is notably larger. To September 1 of this year the combined exports of the three countries were about 69,800 tons per month. For the twelve months of 1913 the corresponding total was 121,600 tons per month. In 1913 Germany's proportion of the total rail exports was 34 per cent.; to September 1 this year it was about 52 per cent., with the German total only about 5,000 tons per month less than in 1913.

Discussion on Monsieur Ronceray's Address on "Foundry Training from Apprenticeship to the Foundry Technical High School."

MR. JOHN CAMERON, J.P. (President of the Institute of British Foundrymen), said his first feeling was one of envy that France had got so far ahead of us. The scheme which had been described was very complete, beginning with the apprentice and passing on to courses of technical training, in which students were encouraged to do independent research. We were not co-ordinated in so complete a manner in this country, though the education of the moulder and of the apprentice had always been of tremendous interest to the Institute of British Foundrymen. That interest, he believed, began with the first President, the late Mr. Robert Buchanan. He was glad to notice that the Birmingham Branch was taking a keen interest in the apprentices, and he urged employers to give the work every support in their power. He admitted that the foundry industry was asleep for many years, but some ten years ago it wakened up. The world war came along, and foundrymen were asked to do things that they had never done before. They were asked to make iron to special tests, and they rose to the occasion. He believed that they were on the eve of improvements, and that the castings for internal combustion engines, locomotives, warship engines, etc., would require to be made to higher tests than had ever before been required. For that reason, if for no other, he considered that the work being done by the Institute of Britsh Foundrymen and the Cast Iron Research Association was invaluable. Theirs was a splendid craft, calling for skill and resource and the facing of difficulties.

Junior Technical Schools.

MR. A. S. BARNES (Senior Inspector of the Board of Education) said there must be co-operation between the trade itself and the schools if there was to be a worthy system of education for the foundry trade. We had in this country a type of school which, so far as he knew, did not exist in France, and that was the junior technical school. The junior technical schools took boys at thirteen years of age from the elementary schools, and for two, and in some cases for three, years gave them a full-time day training in mathematics, drawing, mechanics, science, and in manual instruction in the wood working and metal working shop. Such boys were very efficiently trained, and when they got into the works would develop into charge hands, foremen, etc.

If they wanted the services of a higher grade of boy than they were getting at present they would have to show parents and the boys themselves that there was some sort of a career open to them. They must show that as the reward of ability and hard work there was a chance of attaining a good position. Some modest levy in a centre such as Birmingham would enable them to establish a model foundry or to establish in some existing foundry a day on which apprentices could go for training. In the Birmingham Municipal Technical School and in the Technical Schools at Handsworth, Aston and Wolverhampton, there were foundries and facilities for training in foundry work, although unfortunately they were not fully taken advantage of by the industry. Birmingham seemed to be a very excellent centre for initiating an experiment, both on account of the number of foundries and because of the progressive character of the people.

MR. JOHN D. GOODWIN (Vice-President of the I.B.F.) said the engineering profession was overstocked at the moment, while in the foundry trade there promised to be good openings for professional foundrymen—he did not mean purely academic people, but men who combined both practical and theoretical qualifications. Everything pointed to a greater scope for cast iron in the future. Experts had quite recently visited the Continent to see what progress had been made, and they had brought back a great deal of information. Generally speaking, he did not think this country had much to fear. He believed France was a little bit ahead of them in the work that had been described, though in this country there were certain technical schools which were nearly covering the ground, although they were not specialising solely in foundry work. So far as cast iron research was concerned the Continent had not gone far beyond what was known here, except in isolated cases. He advocated the encouragement of better work by the payment of bonuses. It did not follow that the best teacher was a good workman. The best workman was a man whose whole mind was concentrated on his job, and he very often had neither the ability nor the patience to talk about it. Referring to the fear of losing lads after a great deal of time and trouble had been expended on instructing them, he said his experience during the past 25 years was that they would not leave if they could be made to appreciate what they were doing and why they were doing it.

MR. J. E. FLETCHER expressed the opinion that Mr. Ronceray had outlined a scheme which might be very well regarded as a pattern. It was quite true in this country that we had technical schools and junior technical schools, but they were not doing for the foundryman exactly what was wanted. They were not doing all that might be done to secure that fusion between the scientific and the practical side which ought to exist. They seemed to imagine that the foundry lad was incapable of learning the elementary principles of science. That was not true. He had had to deal with hundreds of them, and many of them had made themselves proficient in science. It was encouragement that the lads needed. Those who employed them must believe in them, and there must exist a personal contact. He had been impressed with the personal relations existing between the heads of firms and their men in America. When once a young fellow got thoroughly enthusiastic about foundry matters he had entered upon a new era. He thought Mr. Ronceray's address would make all of them ask themselves: "Where do I stand; do I know as much as I ought to know as foreman, manager, or as the owner of a foundry?" They could not expect to see the advancement of the craftsman unless they themselves took the intelligent interest in the work which made them themselves experts. He hoped we should soon see in this country evidence that better educational facilities were capable of producing clever moulders as well as clever craftsmen.

DR. R. S. HUTTON (Director of the Non-Ferrous Research Association) said he felt that the unique higher education described by Mr. Ronceray deserved all the emphasis that could be given to it. It was in that direction, he was sure, that we wanted to keep our eyes very clearly fixed. One of our weaknesses lay in the fact that, compared with some other nations, we had not been absorbing men of higher education in our industry. If we had an opportunity of establishing in this country some such scheme of higher education in foundry work as Mr. Ronceray had described, he felt sure it would go a long way towards helping us in the other problem of the apprentices' education. Fortunately science and education had no national frontiers, and we were free to extend our experience as much as possible, but he felt that many in the past had failed to appreciate the enormous fund of experience and knowledge which was available in France.

DR. F. JOHNSON said that he welcomed Mr. Ronceray's address as an event which gave every promise of being epoch-making. There had been too great a tendency in Great Britain to let things drift, in matters concerning the education of foundry workers, in the hope that (to use the lecturer's native tongue) "la chose d'elle-même se fera."

So far as he could see, there was no lack of interest on the part of educational authorities. For

his own department he could speak emphatically, and say that considerable and earnest attention had been given to the special requirements of foundry students. Classes for ironfounders had been successful in the past, but had perforce to be discontinued because of the lack of students. He had this session started a class in Foundry Metallurgy, under the able control of Mr. Arthur Marks, A.R.S.M., and, although there was little response at first, the class had steadily grown in numbers as it became more widely known.

He fully realised that this was only a first step, but such a class could be very helpful to students whose education was of a suitable standard to enable them to take advantage of the instruction given. He looked hopefully for a lead from foundry owners, and he thought that a scheme which enabled a foundry learner to attend part-time day classes would prove to be the most advantageous and efficient.

The training of hand and eye in the works foundry would go on side by side with the scientific training of the mind in the class-room, the two forms of learning being complementary, conducive to efficiency and contributory to the acquisition of an experience of enduring usefulness.

The fusion of the practical and scientific outlook in one brain seemed to be the ideal state at which we should aim. Moreover, the occasional relief afforded by day-time instruction at the school would have an exhilarating effect.

It would not be possible for every learner to pass on to the highest forms of instruction. Examinations and tests would sort out the brighter intellects from the others, but none of the work of training need be abortive.

The speaker expressed the hope that foundry owners would extend every possible encouragement to their young employees to take advantage of any scheme of training which might, with their approval and co-operation, be arranged.

A scheme for granting certificates in metallurgy had already been approved and put into operation in his department. There would be no difficulty in providing, as alternatives to some of the courses in the curriculum of that scheme, classes in foundry subjects.

He expressed regret that, owing to a very pressing engagement, Dr. Sumpner had been unable to stay for the discussion.

MR. F. J. COOK (Chairman of the Research Committee, British Cast Iron Research Association) thought the outline which Mr. Ronceray had given of a syllabus for the training of apprentices would be most useful. One feature of Mr. Ronceray's scheme which had contributed to its success was the fact that they had not attempted to teach everything in connection with the foundry by one man. In his opinion one of the weaknesses of schemes in this country was that the reverse was the case. He was not saying anything derogatory of the teachers in the technical schools, but it was obvious to anyone who had had to deal with technical matters as applied to everyday work that it was impossible to find any one man who could teach everything in the way of applying science to practical work. There were plenty of foundrymen in the county perfectly willing free of cost to undertake a few lessons or lectures in some special subject in which they had specialised. With regard to the junior section which they had started in Birmingham, it had been hoped that the section would have been in the hands of one of the best men in the world, he thought, the late Robert Buchanan. He (Mr. Cook) was trying to step into the breach, and he hoped that everyone with youths under their control would send them along.

MR. V. C. FAULKNER (Sr. Vice-President I.B.F.) expressed the belief that in spite of the excellent system which had been organised in France by Mr. Ronceray more money had been spent in Great Britain on foundry education than in France. What was mainly required here was co-ordination. Many efforts were being made throughout Great Britain, and probably what would meet the immediate needs of the industry was the institution of a national examination. With sufficient enthusiasm for the object such an examination could easily be established, and he was of opinion that the necessary enthusiasm would be forthcoming from the whole of the foundry districts of the country. For instance, he believed that either Sheffield or Birmingham University, or the City and Guilds, could organise and supervise a national examination to be held in all the various centres. That, he was convinced, would meet immediate needs, because, after all, we had in Great Britain a very large number of eminent foundrymen, and it would be well to ask ourselves how they attained that position. If they had a National Examination Board it would greatly enhance the status of the foundryman.

MR. J. G. PEARCE (Director of the British Cast Iron Research Association) said there was no doubt as to the magnitude of the problem before them. It was agreed that there was a shortage of skilled men and an equal shortage of men who could take important managerial positions. It would be possible to get boys into the foundry trade if schemes were developed for teaching the trade thoroughly to all comers and to make it easy for the more ambitious boys to reach the highest positions in the industry. Apprenticeship and shop instruction must go hand in hand with part-time teaching in the technical schools. He wanted quite unofficially to make a rather revolutionary suggestion. It was that conditionally on part-time attendance at the technical school the State should make a grant to properly trained apprentices. To his mind an important feature of the school in Paris was that it brought together under one roof and compelled them to rub shoulders, the ambitious artisan who had come up from the bottom and had been through the shops and the University and technical high school graduate whose practical training had been limited. The industry needed both classes of men, and he thought the formation of a school in this country would be justified on that ground alone. Such a school would have to be provided jointly by the Board of Education and the employers. The latter must find the money jointly with the State and the school must be conducted, so far as the actual teaching was concerned, by men from the industry itself. There would be a Foundry Exhibition in London next June, in connection with which there should be a competition of a practical character for moulders, core makers and pattern makers. He suggested that the six men who did best in those competitions should be permitted to compete among themselves for a scholarship which would entitle the best man, the star young foundryman of Great Britain for the year, to a period of training at the French Foundry High School. He suggested that it should cover a period of eighteen months and probably £150 would cover the expense. Six months would be necessary to learn the language, there would be six months' training at the school and six months to complete the practical training for the Foundry High School diploma. The money should be jointly found by the Research Association, the Institute of British Foundrymen and the Foundry Equipment and Supplies Association.

MR. D. H. WOOD thought the best thanks that could be tendered to Mr. Ronceray would be to put a similar scheme into operation in this country. He moved a resolution to the effect that the meeting, having heard with great interest and satisfaction Mr. Ronceray's description of the training of apprentices and foundry operatives, approved of the formation of a Committee to be constituted to prepare a scheme for similar training in this country and promising full support for the project.

The motion was seconded by Mr. Beech and carried.

Replying to some of the points raised in the discussion, MR. RONCERAY said he did not agree that the training of apprentices could not be properly carried out in small shops. His experience was that in many cases the best apprentices came from small shops where adequate methods had been employed. He welcomed the suggestion made by Mr. Pearce that a boy should be sent over to Paris. They were not selfish, he said: they were anxious to have representatives of other nations. During the first year they had a Spaniard, in the second year a Spaniard and a Czecho-Slovakian, and they were very anxious to have a Britisher.

The Patternmaker and Some of his Work.*

By S. Carr.

An observer of the various classes of workmen entering and leaving the workshops of our engineering factories will doubtless have noticed the change, in comparatively recent years, in the size of the tool-box which shadows the patternmaker from one place of employment to another. His box is smaller and contains less of the tools carried by his forbears, also those he does carry are lighter in weight and are often in combination form. An old-time patternmaker's tool-chest, with its skew and skipjack planes, thumb planes and ploughs, bow and keyhole saws, handscrews, etc., would be a chest of curios to many. In the old days he carried everything with him, except the workshop, and no doubt his tool-chest would have made a good substitute even for that.

It must not be thought that only the modern development of hand tools accounts for the change, but rather the greater development and use of machinery in the patternshops of to-day. There still are shops, however, where men are expected to provide all, and are expected to give a good account of themselves in semi-darkness and a dust-laden atmosphere. If efficiency is to be

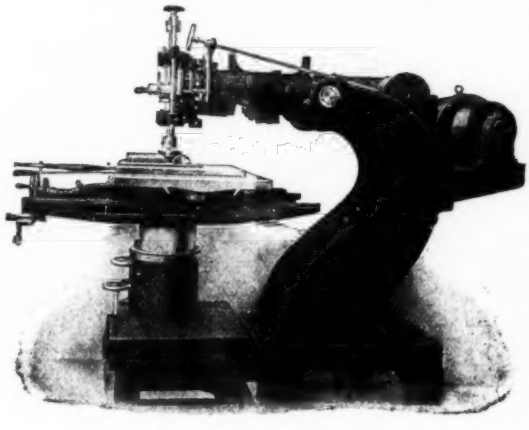


FIG. 1.—MECHANICAL WOODWORKER.

expected then a man must be given good conditions, plenty of light, and a good supply of clean air must be maintained at a reasonable temperature. It is impossible to work with edged tools and numb fingers, or if one has to perform a series of physical jerks to stimulate circulation. A patternshop should be well lighted, and not too low, efficiently heated, and should contain apparatus for removing the shavings and dust from the machines. Cleanliness is essential.

The machinery should be such as to eliminate as many hand operations as possible, such as planing, sawing, sandpapering and turning. There are other operations, such as are involved in corebox construction, that can now be performed by machinery, examples of which will be referred to later. It is necessary that patternshop machinery should be at least in as good a condition as the best used in the fitting shop, and too much emphasis cannot be laid on this point.

All wood-cutting machines are dangerous, and if not kept in first-class condition the danger is materially increased and the full advantage of the machine is lost; for example, when the glass paper on the sander is worn extra pressure must be applied and the result is a scored and burnt surface on the wood. Again, if the cutters on the planing machine are not ground and set true the wood comes off tapered and so requires hand-dressing. With a sharp bandsaw one can cut very close to the line, and only a light contact with the sander disc, or bobbin, is required for finishing, but when the saw is not in good condition a good margin must be left and the work ground down to size on the sander.

Necessity for Broad Knowledge.

Assuming that there is the desired shop and machinery, what of the patternmaker? A good patternmaker is not one who is skilled only in the use of hand tools, but one who is also skilled in the use of machines, and who is able so to construct his work as to get the best results from machinery. His calling also demands that he should have a good knowledge of woodcraft, coupled with ability to read working drawings of both the orthodox and unorthodox types: he must possess a good knowledge of geometry and machine construction, and, most important of all, he must possess the ability to visualise the pattern from a drawing. To this may be added a quotation from a recent publication: "A good patternmaker must be a good moulder." It is possible, by concentration of mind, actually to see the pattern and casting if the elementary rules of machine drawing are thoroughly mastered, and all classes of apprentices should be encouraged in this direction. Both the patternmaker and moulder require higher practical and technical training, particularly in each other's sphere of work; they are interdependent, so that it is insufficient for the patternmaker to understand moulding, but it is necessary for the moulder to understand patternmaking.

A patternmaker who understands patternmaking alone is analogous to the moulder who understands just one type of moulding. Both, if they wish to succeed, must get out of their watertight compartments and increase their knowledge of the modern developments in each other's work, and in engineering generally. If it is accepted as a fact that the pattern is indispensable to the moulder it follows that the patternmaker is essential to the production of castings, and, consequently, his knowledge of foundry work is most necessary. He should understand more than moulding operations alone. He should interest himself in the various types of moulding, the composition of the various sands and the effect of heat upon them; the metal put into the mould, the cupola; in short, in "metal founding."

The degree of accuracy now demanded from the patternmaker and moulder and the intricacy of castings used in modern engineering make it imperative that at least a general knowledge of the function of any particular casting should be known, for such information will assist in deciding the method and type of moulding, machining allowances and certain tolerances. Not only is this knowledge helpful in production, but it is both interesting and instructive, and relieves the monotony of factory life. This knowledge may be readily obtained, for it is difficult to conceive of any branch of engineering upon which it is not possible to get cheap instructive literature written in such a manner as to be interesting and easily understood.

High-class Patterns Necessary.

Turning now to the work of the patternmaker, some men have spent their lives on one class of work only, large or small, or in a particular branch of engineering, while others have had a good general experience, but if a man has a thorough knowledge of the subjects that have been enumerated then he can very quickly adapt himself to any class of patternmaking.

Being the era of modern labour-saving devices, brought to a high state of efficiency, the demand for "apology patterns" should no longer exist. Skeleton or template patterns, except in very exceptional cases, should be committed without ceremony to the cupola, and without the option of resuscitation. Indeed, if the greatest possible advantage is to be taken of the modern moulding machines little short of the perfect pattern will suffice, and with modern patternshop equipment the majority of old-time arguments for a "makeshift job" no longer exist. Time unnecessarily

* A Paper read before the Newcastle Branch of the Institute of British Foundrymen, Mr. M. B. Herbst, Branch President, presiding.

spent on finishing and mending a mould due to a shoddy pattern is lost time, and is a direct charge against the patternshop, and this is only too often overlooked. Surely the final cost of a casting is of more importance than the particular departmental cost.

Where scantlings are reduced to the minimum, and only a small margin is allowed for casting weights over estimated weights, it is essential for the moulder to have an *accurate* pattern, no parts being left for him to carve out of the mess which usually remains after withdrawing certain types of patterns with which he is painfully familiar.

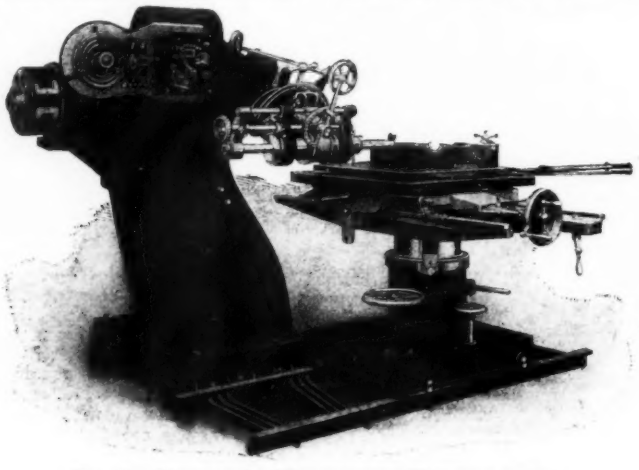


FIG. 2.—MECHANICAL WOODWORKER WORKING WITH THE SPINDLE HORIZONTALLY.

boxes, and other methods were introduced, thus transferring a large amount of pattern and core-box making to the foundry. These methods, while doubtless effective in their object of providing castings, do not permit of a very high degree of accuracy, and liberal machining allowances become necessary, while one has not to be too critical of the appearance of the casting, nor too exacting during calibration. Such castings would not be tolerated in many classes of work to-day, and the patternmaking has to be done in the patternshop.

The ever-increasing demand to do work mechanically caused woodworking machinery engineers to

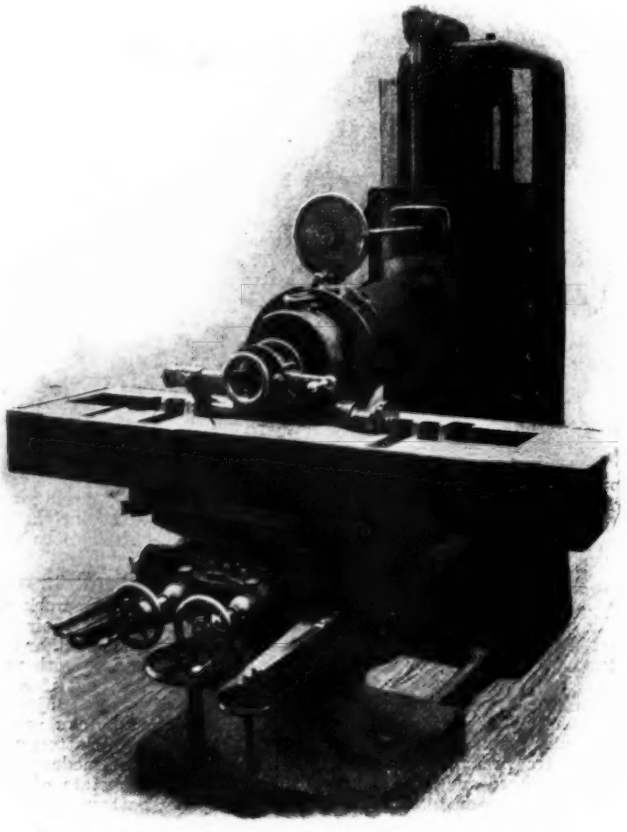


FIG. 3.—SEMI-AUTOMATIC UNIVERSAL WOOD MILLER.

Use of Modern Machinery.

Until quite recently much of the work in the patternshop has been in the nature of handwork, and with the object of reducing this, core frames, strickles, sweeping boards for sand-moulding, loam patterns, thicknessing the mould, loam core make a special study of patternshop requirements, and the result is that to-day there are many first-class machines which reduce hand labour in the patternshop to a minimum. The circular saw, bandsaw, planing machine and wood grinders are all very efficient machines, but the variety of

work produced is very limited, and it is owing to this limitation that the mechanical woodworkers have been evolved.

The Mechanical Woodworker.

Fig. 1 shows one of these machines, which is adapted to cut either patterns or core boxes. The cutter is shown in the vertical position, while on the table of the machine is a bend pipe pattern. As the cutter revolves the table is moved so as to cut the straight portion of the pipe; but on reaching the centre of the radius the table is locked and is then ready for turning, thus enabling the bend portion to be cut. On reaching the straight portion again the locking gear is released and the table moved, thus enabling the inside half of the pattern to be completed. The outer or convex half of the bend is completed in a similar manner. The corebox is treated in the same way, only the shape of the cutter is reversed. The great feature of the machine is the number of operations that can be performed by simple movements. The base of the table can be easily moved along the runway and the table is so constructed that additional movement may be had in the same direction, also in a transverse direction. It can also be turned completely round, so enabling circular work to be completed at one setting, while the height of the table may be altered to suit the work in progress. The cutter spindle can be raised or lowered as desired, while the fine adjustments permit of the highest degree of accuracy. The spindle may be turned through an angle of 90 degrees, and can be locked at any intermediate angle, so enabling taper to be cut on a pattern at one operation. Fig. 2 shows the spindle in a horizontal position. When it is desired to cut long boxes of large diameter a boring bar is used, which has one end attached to the spindle, the other end being supported by means of a suitable standard.

An Improved Woodworker.

A recent development on the preceding machine is shown in Fig. 3. It is known as the "Semi-Auto Universal Wood Miller," and is adapted for larger and heavier classes of work. While possessing the same features as the "Mechanical Woodworker" there are additional advantages. All operations can be controlled from the front of the machine; it will also be noticed that the spindle is below the level of the overhung arm, which obviates the necessity of using a boring bar when cutting long-core boxes. The cutter spindle is gear-driven, and can be reversed or stopped at will, while the speed is controlled to suit the size of cutter used.

Another feature of importance is the "Patent Revoluble Cutter Head" (not shown in the illustration). This permits of a cutter to be operated with its axis at right angles or parallel to the surface of the work, which is a great advantage when cutting pipe coreboxes of large diameter. Another view of the same machine is shown in Fig. 4. A half-corebox for a globe valve, having a maximum diameter of 1 ft., can be finished on a good machine in about one hour, while bend patterns and coreboxes, valve coreboxes, eccentric sheaves, liners, bushes, etc., can be completed in a matter of minutes if in the hands of a skilled operator.

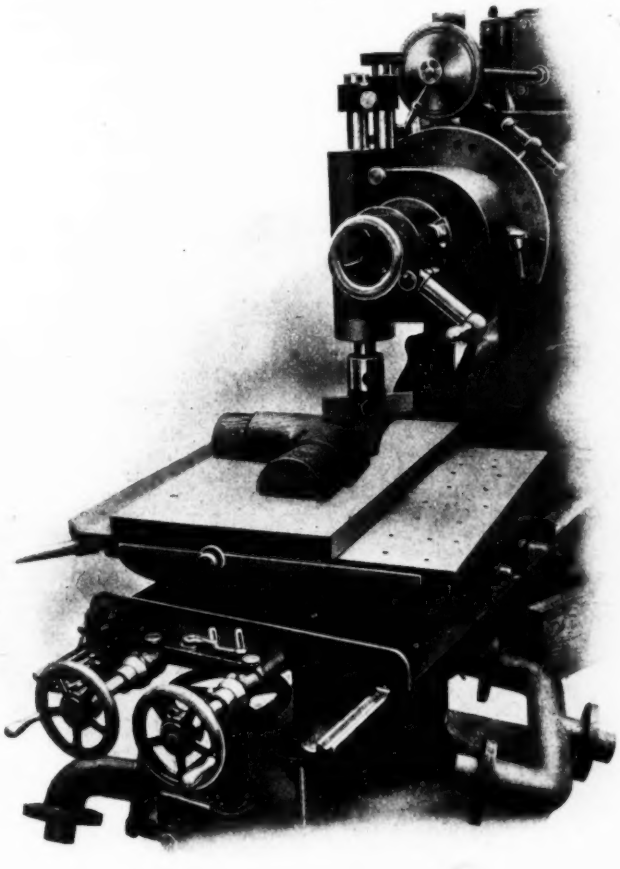


FIG. 4.—ANOTHER VIEW OF THE MACHINE SHOWN IN FIG. 3.

There are several additions provided with these machines for cutting spur and bevel-wheel patterns, mitre wheels, and also worms and worm gears. The feed and timing gear for cutting such wheels is most accurate, while they can be cut in a fraction of the time taken by hand. Much time can also be saved by considering the construction of a corebox or pattern so that the greatest benefit can be derived from the machine.

If the cutters are kept in perfect condition the products of these machines require very little finishing at the bench, while the time saved easily

disposes of the crude foundry-made pattern, and makes a woodworking machine almost indispensable in the patternshop.

A Modern Method of Construction.

Having seen something of what can be accomplished by the use of machinery in the patternshop, the "Building Method" of tee pieces, bends, etc., may be illustrated in a practical manner. (The author here illustrated this section of the Paper by working models.)

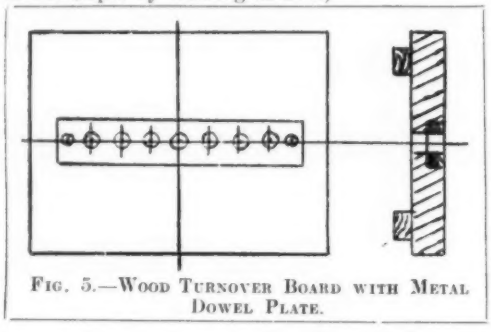


FIG. 5.—WOOD TURNOVER BOARD WITH METAL DOWEL PLATE.

As the tendency of present-day practice is to standardise, many parts of pipes and pipe connections are of standard section. Up to certain pressures the metal is of a constant thickness, for a certain bore, while the flange thickness, diameter, number and diameter of bolts are also constant; consequently, if a tee piece of any given diameter is required for a certain pressure a standard pattern and corebox is made.

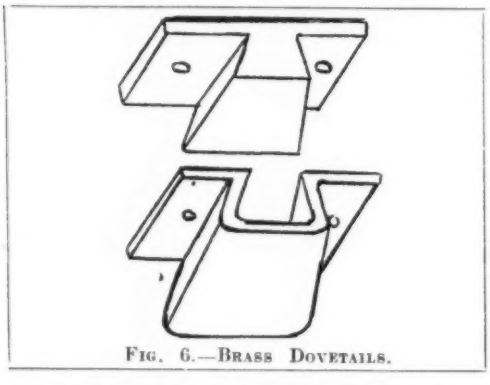


FIG. 6.—BRASS DOVETAILS.

In pipe lines such as boiler-feed, bilge, oil and lubricating systems it is frequently found necessary to vary the diameters of the pipes, and so there may be a 3 in. × 3 in. × 2 in. tee piece or 5 in. × 4½ in. × 3 in., and so on. It is then that a great multiplicity of patterns accumulates and there is also the tendency for the use of the skeleton type of pattern to be persisted in.

In the 3 in. × 3 in. × 2 in. tee piece there are parts of a 3-in. standard and a part of a

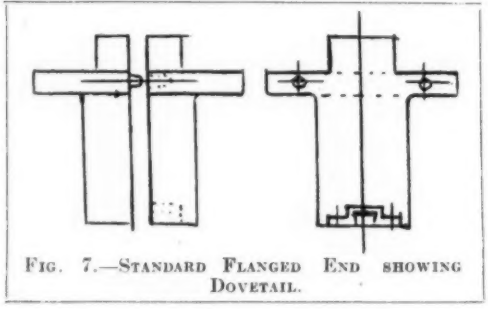


FIG. 7.—STANDARD FLANGED END SHOWING DOVETAIL.

2-in. standard, and when a new pattern 3 in. × 3 in. × 2 in. is made there is overlapping of pattern and corebox construction, extra storage is required, and in the larger sizes of pipes this must be of no small consideration. If instead of making complete new standard patterns they are made in sections as illustrated (Figs. 7 and 8), it will readily be seen that by assembling the parts required from each set any desired combination can be arrived at.

As will be seen from the illustrations, the flanged portions are held in position by brass dovetails (Fig. 6), while the centre portion is dowelled on to the turnover board. The board, if of wood, has a metal plate inserted, the plate being drilled with holes from a jig; the holes are evenly pitched and of such a diameter as to suit the dowels (Fig. 5). When fixing the dowels on to the pattern the drilling jig should be used, and any uncertainty of the pattern fitting into its place is eliminated. Moreover, if several turnover

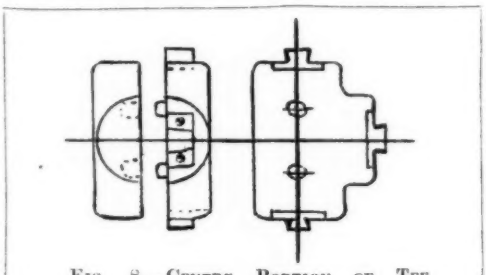


FIG. 8.—CENTRE PORTION OF TEE PIECE SHOWING DOVETAILS AND DOWELS.

boards are in use the patterns will be interchangeable, and any change of formation of the pattern can be carried out in very short time.

The system can very conveniently be applied to the moulding machine, only it is advisable to use a metal pattern plate. The modification required for the pattern is the use of another dovetailed piece in the end flanges, as shown in sketch No. 10. This additional dovetail is kept sufficiently long to cover at least two dowel holes so that after placing the special bolt in position it is sure to suit a dowel hole. The special bolt and wing nut are shown in Figs. 11 and 12. It is possible by this means to reconstruct or remove a pattern from the machine in about one minute. Where special pipe connections are required, such as Y pieces, direction pieces, etc., only the centre portion requires to be constructed, the flanged ends being used as before.

The coreboxes are a very simple proposition, and when making, say, the 3-in. tee piece the box should be made of a cross formation, as this proves very convenient when cross connections are required. The boxes can be quickly cut on the woodworking machine, and in the case of the 3 in. × 3 in. × 2 in. connection a reducing piece can be turned in the lathe, screwed into the core-

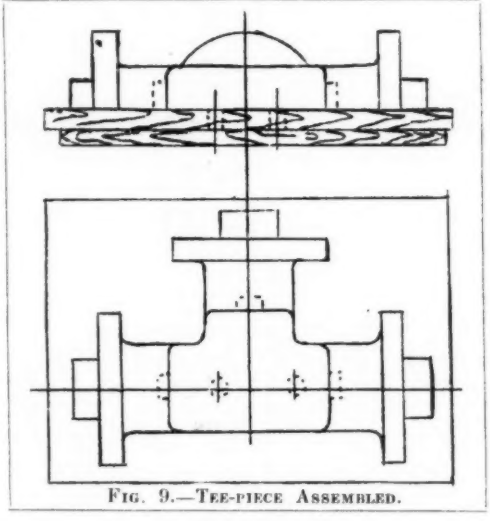


FIG. 9.—TEE-PIECE ASSEMBLED.

box and the machine can cut out the new 2-in. end (Fig. 13). Figs. 14 and 15 show various combinations possible with the system.

Bend Pipe Patterns.

Applying the "Building Method" to bend pipes use is made of the standard flange pieces, while the bend or centre portion is built up from a number of sections of a varying number of degrees. The number of sections for a complete

set of a certain size of pipe is seven, made up of 1, 2, 4, 8, 16, 32 and 64 deg., so that it is possible to get any combination of angles from 1 to 127 deg. Each section has a spigot on one half and a faucet on the other (Fig. 16). The turnover boards have a recess cut, following the radius of the bend into which the spigot half of the pattern is fittec (Fig. 16).

The coreboxes are constructed in degrees similar to the patterns, and are mounted on boards having a recess as in the pattern plate. Each section of the corebox has a spigot so that the whole can be assembled exactly as the pattern. In many cases half-coreboxes will prove sufficient, both for bends and branch pieces. Where machine moulding is adopted, it should be pointed out that, by having the holes arranged

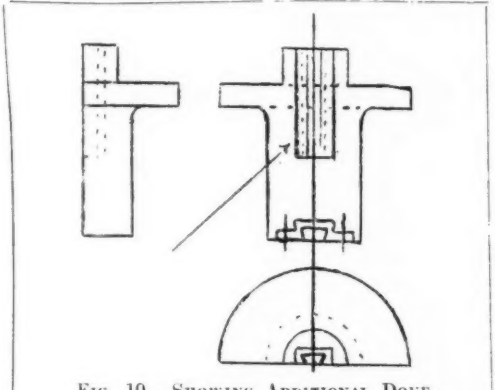


FIG. 10.—SHOWING ADDITIONAL DOVETAIL FOR MACHINE MOULDING.

in the pattern plate so as to be symmetrical, and by using the drilling jig and standard dowels, half-patterns only may be employed, or by using two half patterns together two complete castings can be produced.

The author has endeavoured to show something of what can be produced in a modern patternshop by modern methods of production, and also to draw attention to a system of pattern construction, the principle of which it may be possible to adapt to other classes of work.

In conclusion, the author wishes to thank the Wadkin Woodwork Machinery Company, who so kindly furnished the slides specially for the Paper, and also to Mr. H. Bonner, of Messrs. Grey's, of

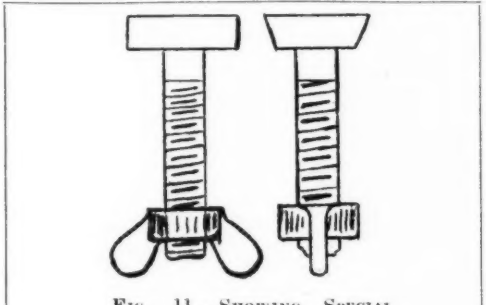


FIG. 11.—SHOWING SPECIAL BOLT FOR MACHINE MOULDING.

West Hartlepool, who gave him permission to make use of the "Building Method" of tee pieces and bends.

DISCUSSION.

MR. J. W. FRIER said he had seen something which he had not seen before, namely, the construction of patterns by the "Building-up Method," although, of course, it might not be new to some people. There were certain things Mr. Carr mentioned in his Paper which touched upon the question of the co-operation of the patternmaker and the foundryman, and the desirability of a better understanding and better working fellowship between them. He had heard it said that the patternmaker was *the* man and that the moulder only came next, but there were also cases where the patternmaker was said to be unnecessary. In such a foundry the moulders worked from drawings, and he had often seen them constructing parts of, say, a cylinder pattern out of a block of loam. The body of the cylinder was swept out with strickles, but the other parts of the coreboxes, he did not see, and, therefore, whether they were part skeleton or otherwise he would not like to say.

Speaking from the foundrymen's point of view, he thought that Mr. Carr's method would be valuable and would save much time in the case of a firm which dealt with standard work, but

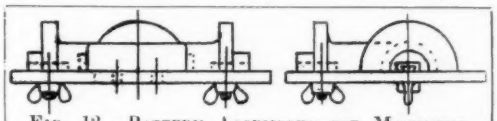


FIG. 12.—PATTERN ASSEMBLED FOR MOULDING MACHINE.

that it could not very well be adopted in a place where jobbing work was done and where patterns were not kept as a general rule. He presumed that the method in question was designed for machine moulding. In his opinion it would have to be changed slightly for certain work. In conclusion he wished to congratulate Mr. Carr upon his very instructive Paper.

MR. HERBST remarked that one point was not very clear to him, namely, how the pattern was fixed to the pattern plate for the machine, because it appeared to him that the nuts would get in the way.

MR. J. M. SMITH said he thought that from the remarks which had been made it was important, especially for the younger members of the craft,

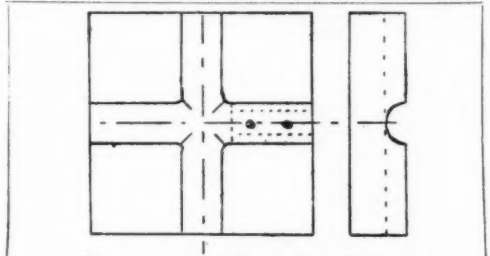


FIG. 13.—CORE BOX: THE REDUCED END IS SHOWN BY DOTTED LINES.

that, as a Branch, they should endeavour to pay a visit to one of the more modern foundries of the district, *i.e.*, one which specialised in machine moulding.

As the lecturer had explained, with machine moulding it was only necessary to use half the pattern. In the foundry the moulding box had to be made of uniform type so that top and bottom could be rammed off one half of the pattern. This applied not only to the particular kind of pattern shown that night, but to all kinds of present-day repeat moulding. It was a most interesting subject, and, to the younger men who had been brought up in a big jobbing foundry, where there was no repetition work, a visit of that nature would be an education in itself.

MR. G. W. SCOTT said the "Building-up Method," which the lecturer had demonstrated,

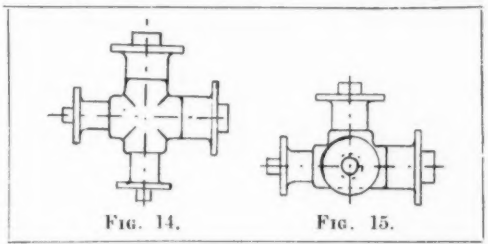


FIG. 14. FIG. 15.

was a very ingenious one, but, of course, would only be useful where the firm had a good system of standardisation. Without that standardisation it would be very difficult to work it with effect. Unfortunately, there were a good many firms which had not yet reached that degree of standardisation, but he quite saw that where this

existed the method would be of great value and would solve some of the more difficult questions in the patternshop.

THE CHAIRMAN said he thought that there was a standard system nowadays for the making of pipes generally. There was also a British standard for flanges, and this ought to reduce the amount of patterns, which had to be kept in stock.

MR. C. GRESTY said that there were one or two small points which appealed to him in connection with Mr. Carr's Paper.

He believed he was right in saying that a great many patterns for repetition work were nowadays made in metal, and he would like the lecturer's opinion as to how long a metal pattern would last as compared with one made of wood. Further, did the castings themselves show any improvement when a highly-polished metal pattern was used? He was also wondering who made these metal patterns and whether there was such a person as a "metal patternmaker."

Another question he wished to ask was whether the patternmaker could help the foundryman out of the difficulty of having to eliminate the use of chaplets? A foundryman was nowadays often ordered to make cast-iron castings without chaplets, and it struck him (the speaker) as being rather a tall order in some cases. Had Mr. Carr had any experience in that respect? Could the shape, size or length of the core prints be altered

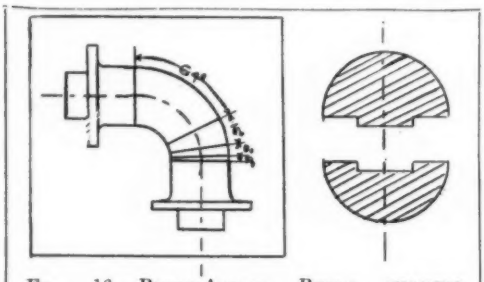


FIG. 16.—RIGHT-ANGLED BENDS SHOWING SECTIONS ASSEMBLED WITH STANDARD ENDS.

to help in this matter? Take, for instance, the ordinary globe valve, which contained one or two chaplets to support the core. Such castings, he believed, could be made without chaplets. Could the lecturer tell him whether, by altering the core prints, anything could be done to give the cores sufficient strength to do without chaplets?

In conclusion, he said that in common with the other speakers he had been very interested in the Paper, and it was the first one he had heard on pattern-making at any meeting of the Institute.

Author's Reply.

In reply to Mr. Frier, with regard to making cylinder patterns out of blocks of loam, Mr. Carr said he had heard of many foundry methods and what was possible in the foundry, but it was the first time he had heard of this being done. Other foundries claimed that they could make pipes out of pieces of sticks. Well, all he could say was that he had seen some of the pipes.

In reply to Mr. Herbst, the degree of accuracy which a patternmaker could attain now was a little higher at least than that of the prehistoric millwright. The patterns could be made on the pattern-plate so as to get the two halves definitely identical. This could be done quite easily with a turnover board, and, personally, he thought that the foundry did not exploit the latter to the extent that they might.

In answer to the Chairman's remarks with regard to the fixing of the pattern to the pattern-plate, the lecturer said that, with a suitable pattern-plate, the nuts did not get in the way as they were arranged so as to be clear of the machine table. Where the casting was symmetrical, one half-pattern only would be required, the top and bottom of the mould being made from the one half-pattern. Where the pattern was not symmetrical, however, it was necessary to use two pattern-plates, each having half of the pattern attached, or to use the two sides of the pattern-plate.

In reply to Mr. Gresty's first question, metal patterns would last a lifetime, whereas, of course, wood ones would not, but, with ordinary care in handling a wood pattern, it would last any amount of castings. He thought that one could get just as clean a mould from a hard wood as from a metal pattern, and did not think there was any difference in the castings produced.

In answer to Mr. Gresty's question as to who made the metal pattern, he said it depended upon the district in which one lived. In some districts there were men who did nothing else but make metal patterns. In a place where these patterns were not made as a general rule, however, the patternmaker did the job if he could get it, but if the authorities said that it could not be made in the pattern shop, then it had to go to the fitting shop. It all depended upon which was the stronger department.

With regard to the elimination of chaplets, whilst the patternmaker could assist the foundryman in that direction, the engineer could assist to a greater extent by designing the casting so that chaplets were not required. The lecturer then illustrated on the board how this could be done in the case of the globe valve.

Vote of Thanks.

A hearty vote of thanks was proposed to the lecturer by MR. C. GRESTY. MR. FRIER seconded, and said it was the first Paper of that type which they had had, and he was only sorry that there were not more patternmakers present to take part in the discussion.

Aluminium Foundry Practice.

Dr. R. J. Anderson, the well-known expert on aluminium, writing in "Mineral Industry" last month, under the caption "Aluminium and Bauxite," stated that sand-casting practice is undergoing some changes with the advent of new and special alloys. In the United States, the number of foundries and foundry departments of manufacturing plants in which aluminium alloys are cast decreased from 2,500 in 1922 to 2,270 in 1924, while in Canada the respective figures are 253 and 206. The modern aluminium-alloy foundry shows vast improvement over the shops of even ten years ago, with the application of mechanical handling equipment adapted to high-speed production. Many interesting and important Papers on various aspects of founding appeared last year, of which only a few can be cited here. Basch and Sayre discuss recent development in the founding of the 95:5 aluminium-silicon alloy; this has good founding qualities—viz., low shrinkage, high fluidity, and freedom from hot-shortness. These properties permit the casting of large and intricate sections not previously attempted. Hurren discusses the effect of pouring temperature on castings, it being indicated that for any given casting there is a short range of temperature at which the alloy should be poured to give the best results. Repeated-impact tests (Eden-Foster machine) show that soaking aluminium-alloy melts causes brittleness of the resultant castings. Lyon discusses the occurrence of "hard spots" in cast aluminium alloys and the effect on the mechanical properites; certain hard spots were found to be an oxide of iron. Dix and Lyon present the results of numerous tests on the relative tensile strength of cast test bars and sections cut from crank-case castings in several aluminium alloys; they show that the strength of the actual casting is to the strength of the separately cast bar as 0.77 to 0.95 is to 1.

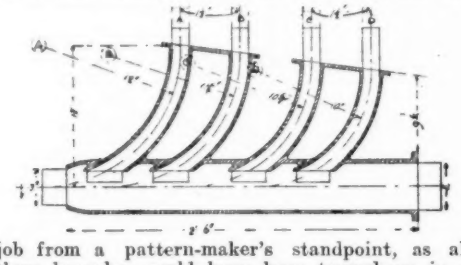
THE WAGES at the Dowlais (Cardiff) Works were the subject of an arbitration, which took place in London recently, when men employed at the works, who are pig-bed workers, crane drivers, lamp attendants, and oilers, claimed increase of wages. The case raised an important general issue. Mr. T. Phillips, secretary of the South Wales and Monmouthshire Iron and Steel Manufacturers' Association, argued that there was no justification for the claims made. The hearing was adjourned until Tuesday, December 15, for further evidence.

An Example of Foundry Departmental Co-operation.

By W. DOBBS.

The thought has many times been expressed, in articles from time to time in THE JOURNAL, that a closer co-operation between drawing office, pattern shop and foundry could be used to a much greater advantage, and result in a considerable saving of time and in a much easier product to produce. When this can be achieved without impairing the efficiency of the ultimate product, it means a great saving in every respect. The accompanying sketch (Fig. 1) describes an exhaust manifold on which, by the co-operation of the departments concerned, resulted in a great saving of time and money.

The example shown is 2 ft. 6 in. overall in length, with four curved branches 12 in. long from centre on the longest end, and 9 in. from the centre on the shortest end; the casting was in aluminium, with general thickness of metal $\frac{1}{8}$ to $\frac{5}{32}$ in. The drawing came to the pattern shop marked "Casting required in 3 days." As extreme accuracy was required as to metal thickness. this looked an impossible job to do in the time, as the shop was very busy at the moment. But on looking very carefully into the job prior to giving it out, it was noticed that the four branches were all of a different radius, A being 12 in., B 11¼ in., C 10⅝ in., D 10 in. This is not an unusual feature on this class of job, but had they been all of one radius, this would have simplified the



job from a pattern-maker's standpoint, as all these branches could have been turned up in a ring on a faceplate, and one loose branch corebox would do for all four cores. This would result in a very great saving of time.

It was the obvious thing to consult the draughtsman, to ascertain whether the required alteration would affect the efficiency of the pipe, and although this had been designed with a special purpose in view, he saw no reason why the desired alteration should not take place. So he altered the radius to suit the short branch D, *i.e.*, making all the radii 10 in. on centre line. The branches could now be turned up in a ring, but actually only six halves could be turned at one time owing to the length; but when the ring was finished, turned, two opposite segments were taken out and two unturned ones inserted in their place, and it only required a few moments to turn these two extra ones down. On this operation alone a saving of 60 per cent. in time was effected, besides getting a much more accurate branch. The corebox was considerably cheapened by the method also, as by making the prints on B, C and D varying lengths, to correspond to the overall length of A, one corebox could be used, as there was a good length of print on the outside and also a reasonable length of bearing in the main core. On this operation also a saving of 75 per cent. was effected, as if the radii had been as at first, four branch coreboxes would have been required, whether made on main coreboxes or not.

When in the foundry the coremaking was much simplified by the branch coreboxes being loose, as instead of an extremely fragile core, it was five separate plain cores. This proved a great advantage when assembling in the mould, as any adjustment could be effected on each branch separately as required, to ensure the even ⅛ in. of metal; also in the cooling and contracting of this class of pipe there is much to be said for the loose branch core principle. The resultant casting was quite satisfactory from all points, and the casting was obtained much earlier than would have been the case had the original design been adhered to.

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Industrial Eye-Protection.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—As manufacturers and suppliers of protection glasses for industrial purposes, we have given considerable attention to the effect of such glasses on radiation, with particular reference to ascertaining which glasses exclude rays likely to prove injurious to workers. The visible rays do not present much difficulty, for ordinary observation will tell the worker if he is suffering from glare from the visible rays, but it has long been known to any who investigate this subject, that many of the dark tinted glasses which would to all appearance be of sufficient density, admit ultra-violet rays freely. This is especially so in the case of the ordinary blue furnace or welding glass, and many of the neutral tinted varieties.

We have now constructed an apparatus which makes a demonstration of the effect on ultra-violet readily visible. This demonstration could be easily understood by anyone unaccustomed to spectroscopic work, and we shall be glad to show this apparatus in use to any employer who is sufficiently interested to test whether the goggles worn by his workers are effective for the purpose designed. Some of the comparisons are surprising. For instance, comparing two neutral glasses of apparently similar density, one admits the ultra-violet rays freely, and the other excludes them entirely. Ordinary blue glass used for furnace work and sometimes for welders, transmits ultra-violet rays which should be cut off.

We trust you will find room to publish this letter in the JOURNAL, as protective glasses in industrial work is a subject which has long been neglected. It may be truly said that we are interested in the sale of goggles, but this is only a small part of our business, and probably the least profitable. There is undoubtedly an enormous amount of preventable eye trouble caused every year through neglect of adequate protection in industrial work, and our real interest is to see that this subject gets the attention which it deserves.—Yours, etc.,

J. AND R. FLEMING, LIMITED.
R. GRANGE.
Safety Goggle Department.
146, Clerkenwell Road,
London, E.C.1.

Zinc-Cadmium Alloys. A Note on Their Shear Strength as Solders.*

By R. B. DEELEY, A.R.S.M.

[SUMMARY.]

The material of this note forms part of an investigation taken up by the British Motor-Cycle and Cycle-car Research Association on the possibility of producing a satisfactory substitute for brazing spelter. The limits of the melting range were fixed by the fact that the working temperature of the substitute solder had to be below that likely to promote coarse crystallisation of the hard-drawn steel tubing of the frame, and, further, that the melting point must be sufficiently above the enamel stoving temperature (about 180 deg. C.) for joints made with the alloy not to fail during the enamelling process.

Tests of zinc-cadmium alloys in pure shear show the strongest alloy to be near the eutectic composition. This alloy is considerably stronger than tinman's solder, 8 tons/sq. in. of alloy in shear being an average value compared with 4 tons/sq. in. for lead-tin solder in a similar joint. At a temperature of 235 deg. C. the alloy has a strength in shear of 48 lbs./sq. in. and at 200 deg. C. of more than 112 lbs./sq. in.

* Read before the Institute of Metals.

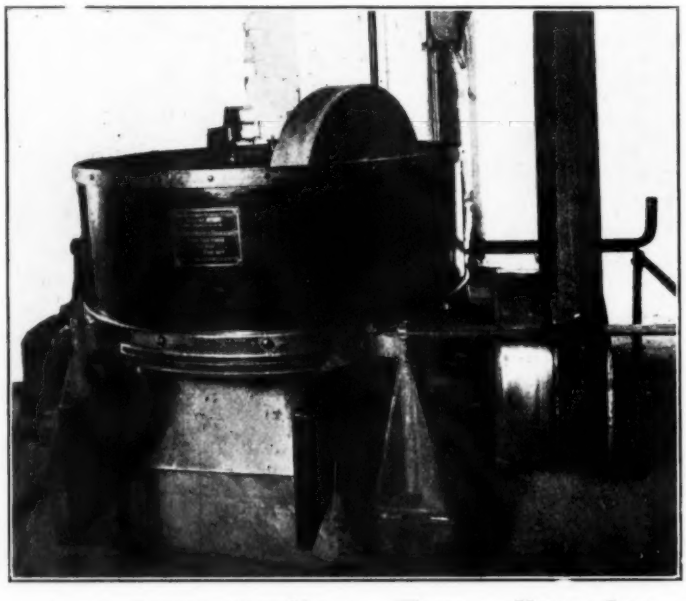
"Simpson" Intensive Foundry Mixer.

On a recent visit to the Halifax Works of Messrs. August's Muffle Furnaces, Limited, our representative witnessed a demonstration of the "Simpson" sand mixer of which this firm are the sole manufacturers. The mixer is of the muller type, but it has little in common with the old-fashioned pan mill which has held the field for so many years, and one of the most serious faults of which lies in the excessively heavy mullers that have a grinding rather than a mixing action. The desideratum, of course, is a muller of sufficient weight and width of face to thoroughly mull and knead the sand so as to produce the necessary plasticity and toughness without destroying the grain and impairing the porosity and openness of the mixture.

The intensive mixer is essentially an engineering proposition carefully designed and soundly constructed in all its details. The usual stationary circular pan is provided with a renewable steel bottom. The supporting casting or cróss-head is keyed to the vertical shaft and rests upon a turret in which are housed the bearings for the vertical shaft, which is operated by bevel gearing located below the machine out of the way of sand and grit. The ploughs and mullers are mounted upon the cross-head, the mountings being provided with screw adjustments so that within limits the mullers can be arranged to work a given height above the floor of the pan. The mountings are fulcrumed so that the mullers and ploughs accommodate themselves relatively. There are two inside and one outside ploughs, so that the sand is turned over and moved alternatively inwards towards the centre of the pan and outwards towards its rim, the pathway of the mullers being at a point where the mixture is heaped up to its highest by the movement of the ploughs.

It is generally recognised in the foundry that the efficiency of any new material entering a mixture depends almost entirely upon the effectiveness of the mixing unit, regardless of the nature of the new material. In the case of the introduction of new moulding sand or clay, it is necessary that the action of the mixing unit be of such a character as to surround each grain of old or burnt sand with the thinnest possible coating of new sand or clay. When a dry or wet binding is being used, it is likewise necessary to coat each grain of sand with the dry binder, wet binder, or oil, whichever may be used. It will be understood that the squeezing, kneading, and constantly turning over in the mill in question will convert the friable and loose mixture into a tough and plastic mass. No hard and fast rule can be given as to time required for mixing a batch of sand; that will depend upon local conditions. Given, however, a sand of normal quality, two minutes would suffice for mixing a batch of core sand, whilst for mixing facing sand three to four minutes would usually suffice.

The automatic discharge is an important feature of the mixer. This is accomplished by having a door located in the bottom of the pan, which is opened by the action of a lever on the side of the machine when the ploughs discharge it down the shute. The required driving power is remarkably small; for example, the No. 2 mixer with 6-ft. dia. pan, 30-in. dia. by 6-in. face mullers, and having a capacity of 7 to 10 cub. ft. per charge, requires a 10-h.p. motor for its operation.



No. 1. INTENSIVE SAND MIXER AT WORKS OF MESSRS. JOHN FOWLER (DON FOUNDRY), LIMITED, SHEFFIELD.

Contracts Open.

Auckland, N.Z., February 8.—Cable, for the Auckland Electric Power Board. The Department of Overseas Trade, Room 52, 35, Old Queen Street, London, S.W.1.

Cambridge, December 23.—Crane, etc., for the Ouse Drainage Board. The Engineer to the Board.

Cape Town, December 30.—Caulking plant, for the Municipality of Cape Town. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Ref. No. A.X. 2604.)

Chorlton, Manchester, December 23.—Bridge, for the Manchester Corporation. The City Engineer's Office, Town Hall, Manchester. Fee, £3 3s., returnable.)

Ilkley, December 21.—Weighbridge, for the Ilkley U.D.C. Mr. J. M. Gameson, surveyor, Town Hall, Ilkley.

Johannesburg, January 28.—Cranes, etc., for the South African Railways and Harbours. The Department of Overseas Trade, 35, Old Queen Street, London, S.W.1. (Ref. A.X.2606.)

London, N.1, January 15.—Iron and steel, etc., for one year commencing April 1, for the Islington Borough Council. Mr. C. G. E. Fletcher, town clerk, Municipal Buildings, Tyndale Place, Upper Street, London, N.1.

Montevideo, January 25.—Meters, for the State Electricity Works of Montevideo. The Department of Overseas Trade (Room 52).

MR. H. A. DAVIES, general manager of the Patent Shaft and Axletree Company, Limited, and Mr. A. H. Westbury, tube manufacturer, have been added to the Commission of the Peace for the borough of Wednesbury.

Sterling BOXES

It's the Rolled Steel Construction that makes Sterlings different. Each box has built into it many years of hard service.

For both jobbing and repetition work

in Iron, Brass, Steel and Aluminium Foundries.

Their lightness, on the other hand, is appreciated by the men who have to handle them day after day. More work is made possible with less effort.

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BEDFORD
London Office: 13, Victoria Street, S.W.1

SIEMENS' STEEL PROCESS

BOILER, SHIP and BRIDGE PLATES, etc. ANGLES and all forms of Sectional Bars. TYRES and AXLES to all requirements. CASTINGS of all kinds and of Largest Sizes. FORGINGS of every description. BILLETS, BLOOMS, RAILS.

SPECIAL STEEL FOR CONSTRUCTIVE PURPOSES.

The STEEL COMPANY OF SCOTLAND, Ltd.

Head Office: 23, ROYAL EXCHANGE SQUARE, GLASGOW.
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STEEL MOULDERS' COMPOSITION, SILICA CEMENT.

J. GRAYSON LOWOOD & Co., Ltd.

DEEPCAR, nr. SHEFFIELD.

Telegrams: "LOWOOD, DEEPCAR."

Trade Talk.

NEW ALLDAYS & ONIONS, LIMITED, Great Western Works, Smallheath, Birmingham, have removed their London office from Holborn to 9, Victoria Street, S.W.1.

A FIRE broke out recently at the Whifflet Foundry, Coatbridge, of R. B. Tennent, Limited. It originated in the tool-house, and spread rapidly to the engineering shop, an erection 100 feet. by 50 feet, which was destroyed.

YARROW & COMPANY (1922), LIMITED, Scotstoun, near Glasgow, have received from the British Admiralty an order for six of their land-type water-tube boilers and superheaters for the electric power station at Portsmouth Dockyard.

FERRANTI, LIMITED, of Hollinwood, have secured an order for transformers for Santiago, Chile. The order comprises two 13,333kva. (18,000 h.p.) three phase 110,000 volts transformers, and several smaller units, to be used in connection with the electrified State railways.

A FIRE of serious dimensions broke out on December 5 at the Queen's Foundry of Hattersley Brothers, Limited, Swinton, near Rotherham. The outbreak was discovered in the range-fitting shop, which is in the middle of the main block of buildings, and this was gutted.

HOLLINGS & GUEST, LIMITED, Thimble Mill Lane, Birmingham, have recently secured two contracts for the supply of hydraulic plant to the High Commissioner for India, comprising bending presses, flanging press, briquetting press, axle forcing press and ingot breaker, to be installed at the East India Railway Locomotive Works at Lucknow and Jamalpur.

PALMERS' SHIPBUILDING AND IRON COMPANY, LIMITED, of Jarrow, have booked an order for two oil tankers for the Gulf Refining Company, of Philadelphia. The engines are being constructed by MacColl & Pollock, Limited, of Sunderland. The company have also secured an order for the reconditioning of the "Melita," a large Canadian Pacific liner.

AFTER A COMPLETE stoppage of operations at the North Lonsdale Ironworks, Ulverston, for the past three or four months, work has now been resumed. In the meantime heavy accumulations of stocks of pig-iron have been practically cleared, and with the improved outlook in trade the directors have put two furnaces into blast. The first was blown in on Saturday and the second during the present week.

THE executive of the Iron and Steel Trades Confederation has passed a resolution directing the attention of the Prime Minister to the parlous condition of the iron and steel industry of this country, and to the adverse competitive factors operating against it which are outside its control, and urging the Government to take immediate steps to prohibit the importation of iron and steel from countries where wages rates and hours of labour are below British standards. This resolution has been duly submitted to the Prime Minister.

AT THE YORK CITY COUNCIL meeting, last week, a member moved the adoption of a tender by Oerlikon, Limited, for the supply of a 6,000 k.w. turbo alternator at the price of £19,000. He said that they had thirty tenders from Switzerland, France, Belgium, Holland, and England. The lowest English tender was something over £24,000. Much of the material under the Oerlikon tender would be made in England, and less than £7,000 would be spent in Switzerland It would save them £500 a year. Another member moved that the recommendation be referred back, and an effort be made to reduce the working cost so as to make the actual cost of British machinery no greater. The amendment, however, was defeated. A further amendment, instructing the committee to purchase a British machine, was also defeated, and the recommendation to purchase the Oerlikon machine was carried by a substantial majority.

FOR SOME TIME imports of foreign steel at the ports of Galveston and Houston have considerably exceeded those at any other ports in the United States, according to the "Iron Age," and the result is that Texas and the South-West is one of the most difficult sections of the country as a market for American steel. While the total amount of foreign steel coming in is not large in relation to the total consumption of the South-West, the imported steel has had a disturbing effect on prices. Indications are that imports of foreign steel will increase during the next year because of better arrangements that are being made for the distribution of such products as can be brought in cheaply. This business has developed now to such an extent that the Markle Steel Company, Houston, Texas, is erecting an all-steel warehouse, 102 x 410 ft., which will carry full stocks of imported steel in all of the finished forms that can successfully be sold, and this steel will be distributed in the regular warehouse manner at prices equivalent to American mill prices plus the freight, with no warehousing differential.

THE LONDON UNDERGROUND ELECTRIC RAILWAY COMPANY propose increasing the output of current at the Lots Road power station, Chelsea, and also at various other points on the company's system. A contract for an additional 15,000 kw. turbo-alternator for Lotts Road has been awarded to C. A. Parsons & Company, Limited, of Newcastle-on-Tyne; whilst the Metropolitan-Vickers Electrical Company, Limited, of Trafford Park, have the order for the alternators, and W. H. Allen, Sons & Company, Limited, of Bedford, are the contractors for the condensing plant. A new semi-automatic sub-station is to be constructed at Lambeth North by John Harvis & Son, Limited, and the contract for the electrical equipment of this station has been placed with the British-Thomson Houston Company, Limited, of Rugby.

EARLY IN THE YEAR it was announced that Walker Brothers (Wigan), Limited, had shipped out to South Africa the largest ventilating plant in the world, comprising an "Indestructible" fan, driven by a tandem compound drop-valve engine, also made by the company. This plant was for the Government gold-mining areas, and had an exhausting capacity of 900,000 cubic feet of free air per minute, with a 7-in. water gauge. Walker Brothers have recently received advice that this plant has been started up with satisfactory results, no hitch having been experienced since the plant was put into operation, the results obtained having exceeded expectations, and the improved working conditions underground having been most marked. The actual erection and starting-up of the plant was carried out by the mining company's staff, a proof of the accuracy with which the plant was made and tested at Wigan.

Company Reports.

Petters, Limited.—Interim dividend on 7½ per cent. cumulative preference shares.

Birmingham Aluminium Castings (1903) Company, Limited.—Dividend, 7 per cent., less tax.

Broughton Copper Company, Limited.—Interim dividend, 5 per cent., actual, less tax, on ordinary.

Partington Steel and Iron Company, Limited.—Dividend on preference shares will not be paid.

Enamelled Hollow-ware Committee.

The committee appointed by the President of the Board of Trade to inquire into and report upon an application by the Enamelled Hollow-ware Section of the Wrought Hollow-ware Trade Employers' Association for the imposition of a duty on enamelled hollow-ware, were to hold their first public meeting for the taking of evidence on Wednesday, December 16, at 11 a.m. Further meetings were fixed for Thursday and Friday, December 17 and 18, at 10.30 a.m. on each occasion. The meetings, which were to have been held at 5, Old Palace Yard, London, S.W.1, have, however, been postponed in consequence of the illness of the chairman.

New Companies.

Banting & Tresilian, Limited, 64, Victoria Street, London, S.W.1.—Capital £1,000 in £1 shares. Mechanical and electrical engineers, etc. Permanent directors: P. E. Banting and A. E. Tresilian.

George Clark (Sheffield), Limited, North British Steel Works, Penistone Road, Sheffield.—Capital £80,000 in £1 shares (20,000 5 per cent. cumulative preference and 60.000 ordinary). Steel manufacturers. Director: G. Clark.

Henry Outram & Sons, Limited, Canal Works, Cadman Street, Sheffield.—Capital £12,500 (£1) (5,000 10 per cent. cumulative preference). File and steel manufacturers. Directors: J. D., J. F., and E. J. Outram.

P. E. Banting (Tubes), Limited, 64, Victoria Street, London, S.W.1.—Capital £4,000 in £1 shares. Merchants of tubes, manufacturers, engineers, merchants, etc. Directors: P. E. Banting (permanent director and chairman) and A. S. Tresilian.

STEEL MANUFACTURERS representing about two-thirds of the British producers and a section of the re-rolling trade, met the Cabinet Committee on Civil Research recently, and appealed for the early imposition of a duty on imported steel. Afterwards a deputation representing the Iron and Steel Trades Confederation met the Committee and set out the figures of unemployment in their unions, contrasting with these the volume of imports of foreign steel, leaving the Committee to form its own conclusions.

BLACKING,
PLUMBAGO,
CORE GUM,
WHITE DUST,
COAL DUST.

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Write for Illustrated Catalogue on Blacking and Foundry Requisites, also for our latest Price List.

NOTICE

NEW ALLDAYS & ONIONS, LTD.,

HAVING PURCHASED THE GOODWILL OF

THWAITES BROS.,

OF BRADFORD,

ARE NOW CONTINUING THE MANUFACTURE OF THE **THWAITES** PRODUCTIONS AT THEIR BIRMINGHAM WORKS.

CUPOLAS, ROOTS BLOWERS, FANS, STEAM AND PNEUMATIC HAMMERS, FURNACES, FOUNDRY AND SMITHY PLANTS, ETC.

ADDRESS ALL ENQUIRIES TO—

NEW ALLDAYS & ONIONS, LTD.,
GREAT WESTERN WORKS,
BIRMINGHAM.

IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—With the near approach of Christmas, business in the Cleveland iron market, as is usual at this season, takes a quieter tendency, nor are such conditions likely to improve until the holiday spirit has disappeared. The recent slight advance on selling prices has, so far, had little effect in checking active buying, but consumers have mostly already completed buying arrangements to cover this year's requirements, whilst also limiting as much as possible quantities in hand, in view of stock taking customary at this period. Consequently makers are adhering firmly to quotations as follow:—No. 1 Cleveland foundry, 69s.; No. 3 Cleveland G.M.B., 66s. 6d.; No. 4 foundry, 65s. 6d.; No. 4 forge, 65s.; mottled and white, 64s. 6d. per ton, all f.o.t. Export prices are sixpence per ton above the home minima.

In the Tees-side district the market for hematite continues strong, production at the moment being inadequate to current demands, and makers, faced with heavier fuel bills, have sought to offset these by adding another sixpence per ton to the current market price. In the case of East Coast hematite there are no fixed prices, but 75s. 6d. is now firmly quoted for mixed numbers and 76s. for No. 1. On the North-West Coast, though prices are hardening, they have not yet advanced, and Bessemer mixed numbers are quoted at £4 1s. 6d. c.i.f. Welsh ports, £4 5s. per ton delivered at Glasgow, £4 8s. 6d. delivered at Sheffield, and £4 12s. 6d. delivered at Birmingham.

LANCASHIRE.—The local demand for foundry pig is still limited in volume, and business generally is on the quiet side, owing to seasonal conditions. For Derbyshire No. 3 foundry iron, 73s., delivered in Manchester, is usually quoted, although some sellers refuse orders at less than 73s. 6d. Lincolnshire iron can be bought at from 71s. 6d. to 72s. per ton, delivered here.

THE MIDLANDS.—The position in the local foundry pig markets has been unaffected by the recent revision of prices, but buying is on quite a moderate scale, for reasons already suggested above. Makers of heavy castings report that business does not show any definite signs of improvement, and what call there is for foundry iron comes mainly from the light casting foundries. Ruling quotations are as follow:—Derbyshire No. 3 foundry, 65s.; Staffordshire No. 3 foundry, 65s.; Northants No. 3 foundry, 62s. 6d.

SCOTLAND.—Notwithstanding the example of Middlesbrough producers, Scotch iron is not any dearer, and the quotation for No. 3 foundry at the furnaces is not more than 77s. Consumers show not the slightest inclination to buy more freely, and, as is generally the case at this time of the year, are inclined to run their stocks down to the lowest ebb, although, generally speaking, there are very few works carrying stocks at the moment.

Finished Iron.

Most manufacturers of finished material are at present only moderately employed, but are looking forward with more confidence to a change for the better before the New Year is far advanced. The makers of nut and bolt iron, although far from busy, are better off at this juncture than they have been for some time, as they are executing orders from the local consumers, who have been held up because of the slow deliveries from the Continent due to the strike. It is reported that supplies are considerably behind, but matters are improving in this respect. It is quite impossible for the local makers to touch the Belgian figure for bolt iron. The Midland quotation is £10 7s. 6d., whereas the foreign product is offered between £6 15s. per ton and £7. As previously reported, marked bars have been reduced to £14 from £14 10s. per ton, which figure has been operative since June. The makers of this class of bar are operating more successfully than the manufacturers of the cheaper grades, as they experience practically no foreign competition.

Steel.

At Sheffield and other centres of the industry, a distinctly more hopeful sentiment prevails, consequent upon the recent placing of some extensive contracts on home and overseas account. In the first-named there is a better demand for semis, acid billets being more freely bought. Basic billets, which have been depressed for so long, are showing some revival, but one is unable at present to speak of the market being active. Open-hearth steel-makers are buying forward to some extent, but, on the whole, purchasers are content to cover little beyond early requirements. The Scottish steel sheetmakers are in a fairly good position, and in some cases can see their works fully employed until February of next year, especially in the galvanised side of the sheet trade. Home trade in sheets is certainly not good, and sheetmakers have principally the export business to thank for their present position, which is undoubtedly the best branch of the steel industry.

Scrap.

Corresponding with the improved demand for pig-iron, the foundry scrap markets also evidence signs of recovery, but prices as yet are considerably lower than has been reported for some time past. At present there is only a small quantity of fine "textile" scrap about, and fairly good prices, up to 75s. per ton, can be obtained for it in Lancashire, but there is plenty of good ordinary cast-scrap on the market, and for this not more than 70s. per ton is now being paid. Founders are perhaps a little busier than they were, and are melting more pig-iron, but the supply of scrap is large and they can easily get all they want. The increased demand recently reported in the Midlands for cast-iron borings is still maintained, and merchants have no difficulty in selling at 32s. 6d. to 35s. per ton, f.o.t. The demand for cast-iron scrap is not great, but the majority of merchants are asking 75s. per ton for the heavy, and 60s. for the light, in both cases delivered to local foundries.

Metals.

Copper.—Values in the standard copper market last week developed a distinctly easier tendency, but have later recovered to some extent. The outlook for the metal is by no means discouraging, as the consuming industries now give promise of fuller employment in the New Year, while American consumption is also reported on a better scale. Current quotations:—*Cash*: Thursday, £59 5s.; Friday, £59 5s.; Monday, £59 2s. 6d.; Tuesday, £59; Wednesday, £59 5s.

Three Months: Thursday, £60 5s.; Friday, £60 5s.; Monday, £60 5s.; Tuesday, £60; Wednesday, £60 5s.

Tin.—Chief interest in the base metal markets is still centred in the tin section, in view of the rather obscure technical position. At times fluctuations have been narrow, but the reduction in the home stocks caused the premium on nearby metal to advance quickly. The position of near tin might be regarded as artificial, as home stocks are small, and it is possible that the covering of near contracts will present a little difficulty, especially as it is believed that December and January dates are held in strong hands. Current quotations:—*Cash*: Thursday, £285; Friday, £283 10s.; Monday, £279 15s.; Tuesday, £275 15s.; Wednesday, £276.

Three Months: Thursday, £279; Friday, £278 15s; Monday, £276 5s.; Tuesday, £272 5s.; Wednesday, £272 15s.

Spelter.—The market for spelter has recovered on a good general trade demand from consumers and against speculative contracts on the short side, while the recent fall was considered overdone. London still stands at below American parity, while consumption is heavy and production is still short of current needs, which are particularly extensive in the United States. Current quotations:—*Ordinary*: Thursday, £38; Friday, £37 13s. 9d.; Monday, £37 10s.; Tuesday, £37 2s. 6d.; Wednesday, £37 15s.

Lead.—The market for soft foreign pig has lately suffered another breakdown for prompt delivery in consequence of excessive arrivals, but this level proved more attractive to dealers, and the market rallied well from the worst. Altogether the outlook is by no means favourable to the maintenance of prices, as very liberal supplies are looked for over the balance of the year, and consumers are only buying from hand to mouth. Current quotations:—*Soft foreign (prompt)*: Thursday, £34 3s. 9d.; Friday, £34 5s.; Monday, £34; Tuesday, £33 16s. 3d.; Wednesday, £34 6s. 3d.

THE BRITISH INSULATED AND HELSBY CABLES, LIMITED, will in future be known as British Insulated Cables, Limited.

HARLAND & WOLFF, LIMITED, have launched during the current year from their establishments at Belfast, Govan and Greenock new vessels representing over 112,000 tons gross, and constructed propelling machinery aggregating 88,000 i.h.p. In addition, their associated yards on the Clyde have launched over 23,000 tons, so that the firm's total output in 1925 is 135,000 tons gross.

ROBSON REFRACTORIES LIMITED

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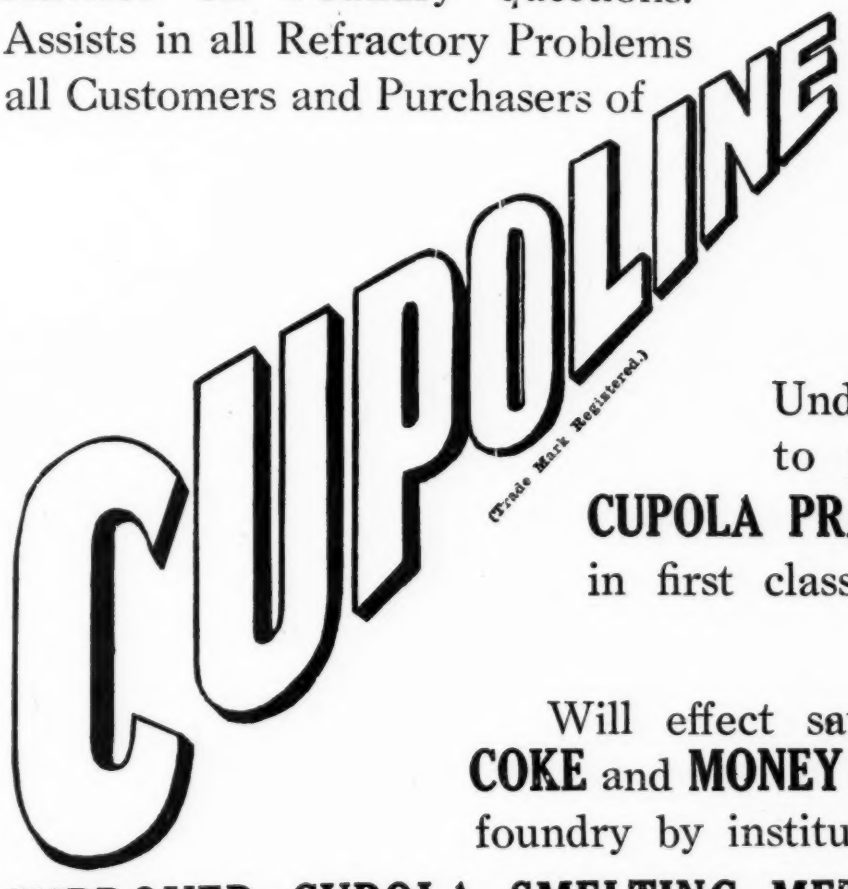
"Our SERVICE DEPARTMENT"
is at your disposal.
Advises on Foundry questions.
Assists in all Refractory Problems
all Customers and Purchasers of



Undertakes
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CUPOLA PRACTICE
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Will effect saving of
COKE and **MONEY** in your
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IMPROVED CUPOLA SMELTING METHODS.

Full proposals will be forwarded on application.

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'Phone 2405. *'Grams: Cupoline.*

CUPOLINE STORAGE DEPOTS AT:
Middlesbrough, Newcastle-on-Tyne, Leith, Newport (Mon.), Garston Docks.

WEEKLY PRICE CURRENT.

COPPER.

	£	s.	d.
Standard cash	59	5	0
Three months	60	5	0
Electrolytic	65	0	0
Tough	61	15	0
Best selected	62	15	0
Sheets	90	0	0
India	77	0	0
Wire bars	65	5	0
Do. Dec.–Jan.	64	15	0
Do. Jan.	64	15	0
Ingot bars	64	15	0
H.C. wire rods	69	5	0
Off. av. cash, Nov. 61	6	10½	
Do., 3 mths. Nov. 62	6	3	
Do., Sttlmnt, Nov. 61	6	5½	
Do., Electro, Nov. 68	2	10⅝	
Do., B.S., Nov.	65	10	0
Aver. spot price copper, Nov.	61	6	5
Do., wire bars, Nov. 68	7	10¼	
Solid drawn tubes		13d.	
Brazed tubes		13d.	
Wire		10d.	

BRASS.

Solid drawn tubes	12d.
Brazed tubes	13½d.
Rods, drawn	11½d.
Rods, extd. or rlld.	7½d.
Sheets to 10 w.g	10½d.
Wire	10½d.
Rolled metal	9⅞d.
Yellow metal rods	7½d.
Do. 4 × 4 Squares	8d.
Do. 4 × 3 Sheets	8½d.

TIN.

	£	s.	d.
Standard cash	276	0	0
Three months	272	15	0
English	275	0	0
Bars	276	15	0
Straits	277	5	0
Australian	276	15	0
Eastern	282	10	0
Banca	282	15	0
Off. aver. cash, Nov.	284	14	1⅜
Do., 3 mths., Nov.	281	14	9⅜
Do., Sttlmt. Nov.	284	13	6⅜
Aver. spot., Nov.	284	13	7

SPELTER.

	£	s.	d.
Ordinary	37	15	0
Remelted	36	0	0
Hard	31	0	0
Electro 99.9	41	10	0
English	37	15	0
India	32	5	0
Zinc dust	46	0	0
Zinc ashes	15	0	0
Off. aver., Nov.	38	13	5 1/12
Aver., spot, Nov.	39	0	9½

LEAD.

	£	s.	d.
Soft foreign ppt.	34	6	3
English	35	10	0
Off. average, Nov.	36	10	10
Average spot, Nov.	36	17	5½

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	46	0	0
Do. V.M. ex whf.	45	0	0
Rods	52	0	0
Boiler plates	44	0	0
Battery plates	44	10	0

ANTIMONY.

	£	s.	d.
Special brands, Eng.	89	10	0
Chinese	82	10	0
Crude	63	0	0

QUICKSILVER.

	£	s.	d.
Quicksilver	15	0	0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro silicon 25%	£9 10 0
45/50%	£11 17 6
75%	£21 10 0
Ferro-vanadium— 35/40%	15/6 lb. va.
Ferro-molybdenum— 70/75% c. free	9/– to 6/3 lb.
Ferro-titanium— 23/25% carbonless	1/1 lb.
Ferro-phosphorus, 20/25%,	£20 0 0
Ferro-tungsten— 80/85%, c.fr.	1/8 lb. to 1/8½
Tungsten metal powder— 98/99%	1/11 to 2/– lb.
Ferro-chrome— 2/4% car.	£34 15 0
4/6% car.	£23 10 0
6/8% car.	£23 2 6
8/10% car.	£22 15 0
Ferro-chrome— Max. 2% car.	£41 0 0
Max. 1% car.	£49 0 0
Max. 0.70% car.	£56 10 0
70%, carbonless	1/5 lb.
Nickel—99%, cubes or pellets	£172 to £177
Cobalt metal—98/99%	10/– lb.
Aluminium 98/99%	£120
Metallic Chromium— 96/98%	3/9 lb.
Ferro-manganese (net)— 76/80%, loose	£15 7 6
76/80%, packed	£16 7 6
76/80%, export	£15 5 0
Metallic manganese— 94/96%, carbonless	2/– lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

	s.	d.
Finished bars, 14% tungsten	2	6
Finished bars, 18% tungsten	3	0

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares 3 in. and over	4d. lb.
Rounds and squares under ½ in. to ¼ in.	3d. lb.
Do. under ¼in. to ⅛ in.	1/– lb.
Flats, ¼in. × ¼in. to under 1 in. × ⅜ in.	3d. lb.
Do. under ¼in. × ¼in.	1/– lb
Bevels of approved sizes and sections	6d. lb.
Bars cut to length	10% extra
Scrap from high-speed tool steel— Scrap pieces	3d.
Turningds and warf	1d.

Per lb. net, d/s steel makers' work

SCRAP.

	£	s.	d.	£	s.	d.
South Wales— Hvy. steel		3	10	0		
Bundled steel & shrngs.	3	2	6	to 3	6	0
Mixed iron & steel	3	0	0	to 3	2	6
Heavy cast iron	3	2	6	to 3	6	0
Good machinery for foundries		3	7	6		
Cleveland— Heavy steel		3	1	0		
Steel turnings		2	2	6		
Cast iron borings		2	0	0		
Heavy forge		4	3	6		
Bushelled scrap		3	5	0		
Cast-iron scrap	3	0	0	to 3	1	0
Lancashire— Cast-iron scrap	3	10	0	to 3	12	6
Heavy wrought		3	7	6		
Steel turnings		2	0	0		
London — Merchants' buying prices delivered yard.						
Copper (clean)		51	0	0		
Brass (clean)		39	0	0		
Lead (less usual draft)		31	0	0		
Tea lead		27	0	0		
Zinc		25	0	0		
New aluminium cuttings		92	0	0		
Braziery copper		46	0	0		
Gunmetal		46	0	0		
Hollow pewter		195	0	0		
Shaped black pewter		142	0	0		

PIG-IRON.

(*f.o.t. unless otherwise stated*).

N.E. Coast— Foundry No. 1	69/–
Foundry No. 3	66/6
Foundry No. 4	65/6
Forge No. 4	65/–
Hematite No. 1	76/–
Hematite M/Nos.	75/6
N.W. Coast— Hem. M/Nos. d/d Glas.	85/–
,, d/d Birm.	92/6
Midlands — Staffs common*	—
,, No 4 forge	59/6
,, No. 3 foundry	65/–
Shrops. basic	70/–
,, Cold blast, ord.*	185/–
,, ,, roll iron*	190/–
* d/d Birmingham.	
Northants forge	55/9
,, fdry No. 3	62/6
Derbyshire forge	59/6
,, fdry. No. 3	65/–
,, basic	65/–
Scotland— Foundry No. 1	82/–
,, No. 3	77/–
Hem. M/Nos.	77/6
Sheffield (d/d district)— Derby forge	63/6
,, fdry. No. 3	69/–
Lincs. forge	68/–
,, fdry. No. 3	70/–
E.C. hematite	86/–
W.C. hematite	88/6
Lincs. (at furnaces)— Forge No. 4	62/–
Foundry No. 3	64/–
Basic	64/–
Lancashire (d/d eq. Man.)— Derby forge	67/–
,, fdry. No. 2	73/–
Northants foundry No. 3	75/3
Dalzell, No. 3	110/–
Summerlee, No. 3	94/6
Glengarnock, No. 3	94/6
Gartsherrie, No. 3	94/6
Monkland No. 3	94/6
Coltness, No. 3	94/6
Shotts, No. 3	94/6

FINISHED IRON & STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£	s.	d.	£	s.	d.
Iron— Bars (cr.)	11	5	0	to 12	10	0
Angles				11	10	0
Tees to 3 united ins.				12	0	0
Nut and bolt				11	0	0
Hoops	14	0	0	to 15	0	0
Marked bars (Staffs.) f.o.t.				14	0	0
Gas strip	12	10	0	to 12	15	0
Bolts and nuts ⅜ in. × 4 in.				16	15	0
Steel— Ship plates	7	5	0	to 8	7	6
Boiler plts.				11	10	0
Chequer plts.	£9	5	0	to 9	15	0
Angles	£7	0	0	to 7	5	0
Tees	£8	0	0	to 8	5	0
Channels	£6	12	6	to 7	2	6
Joists	£7	0	0	to 7	5	0
Rounds and Squares 3 in. to 5½ ins.				8	10	0
Rounds under 3 in. to ⅜ in.				8	5	0
Flats, over 5 in. wide and up				9	0	0
Flats, 5in. to 1½in.				8	0	0
Rails, heavy				8	0	0
Fishplates				12	0	0
Hoops (Staffs.)				10	10	0
Black sheets, 24g.				11	5	0
Galv. cor. sheets, 24g.				16	15	0
Galv. fencing wire 8g. plain				14	0	0
Billets, soft	£6	0	0	to 7	10	0
Billets, hard				8	2	6
Sheet bars				6	5	0
Tin bars d/d				6	5	0

PHOSPHOR BRONZE.

	Per lb.	basis.
Strip	1	3
Sheet to w.g.	1	3½
Wire	1	3½
Rods	1	3
Tubes	1	8½
Castings	1	2

Delivery 3 cwt. free

10% phos. cop. £40 above B.S.
15% phos. cop. £50 above B.S.
Phosphor tin (5%) £30 above price of English ingots.

C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	9d. to 1/3
Rolled— To 9 in. wide	1/3 to 1/9
To 12 in. wide	1/3½ to 1/9½
To 15 in. wide	1/3½ to 1/9½
To 18 in. wide	1/4 to 1/10
To 21 in. wide	1/4½ to 1/10½
To 25 in. wide	1/5 to 1/11
Ingots for spoons and forks	9d. to 1/5½
Ingots rolled to spoon size	1/– to 1/8½
Wire round— 3/0 to 10 G.	1/6½ to 2/1½

with extras according to gauge.

AMERICAN IRON & STEEL.

At Pittsburgh unless otherwise stated.	Dols.
No. 2X foundry, Phila.	24.26
No. 2 foundry, Valley	22.26
No. 2 foundry, Birm.	22.00
Basic	21.76
Bessemer	22.76
Malleable	22.26
Grey forge	21.76
Ferro-mang. 80% d/d	115.00
Bess. rails, h'y, at mill	43.00
O.-h. rails, h'y at mill	43.00
Bess billets	35.00
O.-h. billets	35.00
O.-h. sheet bars	36.00
Wire rods	45.00
	Cents.
Iron bars, Phila.	2.22
Steel bars	2.00
Tank plates	1.90
Beams, etc.	1.90
Skelp, grooved steel	1.90
Skelp, sheared steel	1.90
Steel hoops	2.50
Sheets, black, No. 28	3.25
Sheets, galv., No. 28	4.60
Sheets, blue an'l'd, 9 & 10	2.50
Wire nails	2.65
Plain wire	2.50
Barbed wire, galv.	3.35
Tinplate, 100 lb. box	$5.50

COKE (at ovens).

Welsh foundry	32/6 to 37/6
,, furnace	20/– to 25/–
Durham & North. foundry	30/– to 33/–
,, furnace	17/6
Other Districts, foundry	30/– to 33/–
,, ,, furnace (basis)	11/9

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. Cokes,	20×14, box	20/1½
,,	28×20, ,,	40/3
,,	20×10, ,,	29/3
,,	18¾×14, ,,	21/–
C.W.	20×14, ,,	18/4½
,,	28×20, ,,	36/4½
,,	20×10, ,,	25/1½
,,	18¾×14, ,,	18/10½

Terneplates 28 × 20, 36/3 per box basis f.o.b.

SWEDISH IRON.

Bars, hammered	£19/0 to £20/0
Rolled Ord.	£16/0/0 to £16/10/0
Nail rods	£16 5 0 to £16 15 0
Keg. steel nom.	£33 to £35
Faggot steel nom.	£22 to £25
Blooms, according to quality	£10 to £14
Pig-iron	£6 15 0 to £7 0 0

all f.o.b. Gothenburg.

TUBES.

	Up to and incl. 6 in.
Gas	55%
Water	50%
Steam	45%

Tube prices are now free.

DAILY FLUCTUATIONS.

Standard Copper (Cash).

	£	s.	d.	
Dec. 10	59	5	0	No change
,, 11	59	5	0	,, ,,
,, 14	59	2	6	dec. 2/6
,, 15	59	0	0	,, 2/6
,, 16	59	5	0	inc. 5/-

Electrolytic Copper.

	£	s.	d.	
Dec. 10	65	5	0	No change
,, 11	65	10	0	inc. 5/-
,, 14	65	5	0	dec. 5/-
,, 15	64	15	0	,, 10/-
,, 16	65	0	0	inc. 5/-

Standard Tin (Cash).

	£	s.	d.	
Dec. 10	285	0	0	dec. 47/6
,, 11	283	10	0	,, 30/-
,, 14	279	15	0	,, 75/0
,, 15	275	15	0	,, 80/-
,, 16	276	0	0	inc. 5/-

Tin (English ingots).

	£	s.	d.	
Dec. 10	284	0	0	dec. 50/-
,, 11	282	10	0	,, 30/-
,, 14	278	15	0	,, 75/-
,, 15	274	15	0	,, 80/-
,, 16	275	0	0	inc. 5/-

Zinc Sheets (English).

	£	s.	d.	
Dec. 10	46	0	0	dec. 10/-
,, 11	46	0	0	No change
,, 14	46	0	0	,, ,,
,, 15	46	0	0	,, ,,
,, 16	46	0	0	,, ,,

Spelter (ordinary).

	£	s.	d.	
Dec. 10	38	0	0	dec. 5/-
,, 11	37	13	9	,, 6/3
,, 14	37	10	0	,, 3/9
,, 15	37	2	6	,, 7/6
,, 16	37	15	0	inc. 12/6

Lead (English).

	£	s.	d.	
Dec. 10	35	15	0	No change
,, 11	35	15	0	,, ,,
,, 14	35	5	0	dec. 10/-
,, 15	35	5	0	No change
,, 16	35	10	0	inc. 5/-

Exports of Iron Castings in November and the eleven months, 1925, compared with November and the eleven months, 1924.

	Nov., 1924.	Nov. 1925.	Eleven months, 1924.	Eleven months, 1925.	Nov. 1924.	Nov., 1925.	Eleven months, 1924.	Eleven months, 1925.
	Tons.	Tons.	Tons.	Tons.	£	£	£	£
BUILDERS' CASTINGS :—								
Stoves, Grates, etc., Cisterns, Baths, etc., and cooking and washing boilers :—								
To Argentine Republic	189	143	1,330	1,454	7,253	6,079	47,370	53,681
,, British South Africa	328	336	2,990	3,501	10,399	11,323	102,510	122,091
,, ,, East Indies	159	152	1,245	1,600	6,202	5,885	52,221	72,294
,, Australia	75	89	752	693	4,074	4,908	41,902	38,859
,, New Zealand	317	228	2,008	2,538	14,821	9,874	98,158	117,635
,, Other countries	816	853	6,187	7,489	35,892	42,709	308,779	380,542
Total	1,884	1,801	14,512	17,275	78,641	80,778	650,940	785,102
PIPES AND FITTINGS :—								
Cast—								
To Argentine Republic	971	170	8,160	10,040	13,625	2,267	114,440	129,174
,, British South Africa	232	223	6,302	5,658	4,539	4,204	83,658	82,963
,, ,, India	966	755	10,433	8,954	13,369	9,525	153,487	127,669
,, Straits Sttlmts. & Malay States	100	350	7,911	5,418	1,531	3,961	99,464	63,181
,, Ceylon	135	203	1,017	1,296	1,866	2,502	14,274	16,256
,, Australia	134	209	3,929	2,844	2,337	2,544	61,162	45,146
,, Other countries	4,300	3,344	40,273	50,320	76,198	51,050	682,592	742,803
Total	6,838	5,254	78,025	84,530	113,465	76,053	1,209,077	1,207,192
HOLLOW-WARE :—								
Cast, not Enamelled, & Cast, Tinned	669	623	6,137	7,519	24,064	22,996	242,214	255,273
,, Enamelled	89	105	982	943	9,156	9,684	101,174	95,964
CASTINGS in the rough :—								
Iron	114	121	1,399	1,552	4,896	3,836	57,156	54,550
Steel	64	182	2,112	871	2,937	6,322	42,922	35,721

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PIG IRON

SCOTCH, MIDDLESBRO', HEMATITE, BASIC, SPECIALS, &c.,

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM COLVIN & COMPANY,

ROYAL EXCHANGE, MIDDLESBROUGH.

93, HOPE STREET, GLASGOW.

SMALL ADVERTISEMENTS.

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SITUATIONS VACANT AND WANTED.

STEEL FOUNDRY MANAGER AND METALLURGIST, desirous change; seven years present position; excellent Foundry record; experienced Tropenas Converter and Siemens.—Box 552, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

CHARGEHAND wanted for Modern Brass Foundry in South Midlands; must be fully experienced in the economical production of large and complicated Gun-metal Castings. — Apply, stating age, wages required and fullest details of experience, to Box 550, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

REPRESENTATIVES required for the Sale of Core Oils and Cream by an established Oil Firm on good commission terms.—Write, giving full particulars, Box 554, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

WANTED, thoroughly competent Man with executive ability; able to take charge of large Malleable Plant (Black Heart). State age and experience.—Apply Box 548, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

CITY OF BIRMINGHAM EDUCATION COMMITTEE.

HANDSWORTH JUNIOR DAY TECHNICAL SCHOOL.

A full-time Teacher of Engineering Pattern-making is required for service in the above School. Applicants should have had experience in the engineering trade and in teaching.

Salary in accordance with the revised Burnham Provincial Technical Scale.

Forms of application may be obtained from the undersigned, and must be returned (in envelopes endorsed "H.E. Dept.") not later than the 29th December.

P. D. INNES,
Chief Education Officer.

Higher Education Dept.,
Education Office,
Margaret Street,
Birmingham.

AGENCY.

AGENT.—Experienced Man, calling on Engineers and General Manufacturers in London and District, requires Agency, Grey Iron, suitable for machining.—Reply Box 562, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

PATENTS.

PATENTS AND DESIGNS ACTS, 1907 & 1919.—The Proprietor of British Patent No. 200,117 is prepared to sell the patent or to license British Manufacturers to work thereunder. It relates to metallurgical blast furnaces and methods of operating them.—Address, B. W. & T., 112, Hatton Garden, London, E.C.1.

PATENTS AND DESIGNS ACTS, 1907 & 1919.—The Proprietor of British Patent No. 155,301 is prepared to sell the patent or to license British Manufacturers to work thereunder. It comprises feeding spaced stacks of tinplate bars through heating chambers.—Address, B. W. & T., 112, Hatton Garden, London, E.C.1.

MACHINERY.

WANTED, Crucible Furnace, Coke fired, up to 100 or 150 lbs.; tilting type preferred; any make.—Full particulars and lowest price to Box 560, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

TWO OSBORN ROLLOVER JOLTERS, 40 in. x 50 in. size; new; exceptional opportunity; £250 each.—Box 556, Offices of THE FOUNDRY TRADE JOURNAL, Bessemer House, 5, Duke Street, Adelphi, London, W.C.2.

MACHINERY.—*Continued.*

FOR SALE.—20-in. and 24-in. Hall's Invincible Sand Mixers; the original and best machine in the market for mixing old and new Foundry Sand, Coal Dust, etc.—Apply, PENNEY & PORTER (ENG.), LTD., Lincoln.

SAND MIXERS.—New and second-hand. Ask us to quote.—W. BREALEY & COMPANY, LTD., Russell Street, Sheffield.

MACHINERY, PLANT, &c.

New 2½-in. "Central Thrust"-type HORIZONTAL BORING MACHINE, by The Dickinson Machine Tool Co.

14-in. stroke DOUBLE-HEADED SHAPING MACHINE, traversing heads, two tables, 17 in. x 14 in. x 13½ in., by Butler & Co.

RACK-DRIVEN PLANING MACHINE, to plane 8 ft. x 2 ft. 6 in. x 2 ft. 6 in. one tool box, by American Tool Works.

4-ft. RADIAL DRILLING MACHINE, cone drive, 2-in. spindle, box table 34 in. x 25 in. x 28½ in.

Two very good dish-ended LANCASHIRE BOILERS, by Thompson, 30 ft. x 8 ft.; reinsure for 140 lbs. per sq. inch working pressure; ready for despatch.

TWO VERTICAL COCHRAN LAND-TYPE BOILERS, 14 ft. high x 7 ft. diam.; new in 1917; heating surface about 500 sq. ft. per boiler; 100 lbs. working pressure.

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PATTERNS.—Inquiries solicited; quotations by return; shop equipped with modern machinery; quick delivery.—CLEGHORN & COMPANY, Midland Pattern Works, Spring Gardens, Worcester. Phone 264.

WHEN IN DOUBT send your orders or inquiries for Materials and Requisites for Iron and Brass Foundries to WILLIAM OLSEN, LIMITED, COGAN STREET, HULL. Largest stock; prompt deliveries; carriage paid terms.

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In "Doric" Metal Flux you get a maximum efficiency in Castings.

Liquidiser of Metals. Purifies the Metal.

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Write us freely. Your enquiries get personal attention.

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4'-6" THWAITES, new condition, with spark arrester and receiver, built 1921, little used, at Slough .. £95
3'-0" CONSTRUCTIONAL, nearly new, ready immediate delivery (at Slough) £48
2'-6" CUPOLETTE, with fan and pipes £26

LADLES

12 Ton EVANS, practically unused £85
5 Ton STEVENSON, as new £45
3 Ton THWAITES, NEW, UNUSED £32
2½ Ton EVANS, good as new £26
1½ Ton EVANS, NEW, UNUSED £24

BUY FROM ME AND SAVE MONEY.

ALEX. HAMMOND,
FOUNDRY MACHINERY MERCHANT,
"BOXTED," SLOUGH.